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Abstracts

Benefits, Harms and Costs of Cancer Screening Programs/Factors Influencing Policy and Decision Making (Breast)

Overdiagnosis in screening mammography in Denmark

Njor SH[1], Olsen AH[2], Blichert-Toft M[3], Schwartz W[4], Vejborg I[5], Lynge E[1]

[1]University of Copenhagen, Copenhagen, Denmark; [2]University of Tromsø, Tromsø, Norway; [3]Danish Breast Cancer Cooperative Group, Copenhagen, Denmark; [4]University Hospital Odense, Odense, Denmark; [5]University Hospital Copenhagen, Copenhagen, Denmark

Background: Overdiagnosis is a potentially serious side effect of screening mammography. We used data from two long-standing, population-based screening programs to study overdiagnosis.

Methods: In Denmark, screening mammography started for women aged 50–69 in Copenhagen in 1991 and in Funen in 1993. We followed breast cancer incidence, including ductal carcinoma in situ (DCIS), in invited cohorts until 2009. The rest of Denmark had no screening. We use historical control groups from screening regions, national control groups from the rest of Denmark, and historical, national control groups. Relative risk (RR) of breast cancer in women invited to screening as compared to non-invited women was estimated using Poisson regression.

Results: Screening start led to prevalence peaks in breast cancer incidence; RR 2.06 (95 percent confidence interval (CI) 1.64-2.59) for Copenhagen and 1.84 (95 percent CI 1.46-2.32) for Funen. During subsequent screening rounds, RRs were slightly above unity; 1.04 (95 percent CI 0.85-1.27) and 1.14 (95 percent CI 0.98-1.32), respectively. A compensatory dip was seen after end of screening invitation; RRs 0.80 (95 percent CI 0.65-0.98) and 0.67 (95 percent CI 0.55-0.81), respectively, during the first 4 years. The RR of breast cancer accumulated over the entire follow-up period was 1.06 (95 percent CI 0.90-1.25) for Copenhagen and 1.01 (95 percent CI 0.93-1.10) for Funen. RRs for participants were estimated to be 1.08 and 1.02, respectively.

Conclusion: Our study indicated that the amount of overdiagnosis was most likely 2.3 percent with a maximum of 6.7 percent in invited women. Among participants the amount of overdiagnosis is most likely 1-5 percent. It took approximately eight years after end of screening to compensate for the excess incidence during screening.

Review of the impact of population-based screening with mammography on breast cancer mortality in Europe

Broeders M[1], Moss S[2], Nyström L[3], Njor S[4], Jonsson H[3], Paap E[1], Massat N[5], Duffy S[5], Lynge E[4], Paci E[6]

[1]Radboud University Nijmegen Medical Centre and National Expert and Training Centre for Breast Cancer Screening, Nijmegen, The Netherlands; [2]Institute of Cancer Research, Sutton, Surrey, United Kingdom; [3]Umeå University, Umeå, Sweden; [4]University of Copenhagen, Denmark; [5]Centre for Cancer Prevention, Wolfson Institute for Preventive Medicine, Barts and the London School of Medicine and Dentistry, Queen Mary University of London, United Kingdom; [6]Cancer Prevention and Research Institute (ISPO), Florence, Italy

Background: Mammography screening today is the subject of controversy. We aimed to assess the impact of population-based screening with mammography in Europe on breast cancer mortality and to provide a best estimate for the effectiveness of such screening in Europe to date, bearing in mind the different methodologies and limitations of the published data available.

Methods: Studies were identified through a systematic literature search and summarized in three design categories: trend studies (n=17), incidence-based mortality (IBM) studies (n=20), and case-control (CC) studies (n=8). Estimates of the reduction in breast cancer mortality for women invited versus not invited and/or for women screened versus not screened were obtained from the original papers. The results of IBM studies—i.e., studies based on breast cancer deaths in women eligible for screening and at risk for breast cancer—and CC studies were pooled using the inverse variance method and random effect analyses.

Results: Of the 17 trend studies reviewed only 12 performed an analysis quantifying the impact of population-based screening on breast cancer mortality. Outcomes suggested breast cancer mortality reductions ranging from 1 to 9 percent per year in those studies that estimated an annual percentage change and reductions in the range of 28 to 36 percent in those that compared a post-screening with a pre-screening period. In the IBM studies, the estimated mortality reduction based on all IBM studies without overlapping data was 25 percent (RR=0.75, 95 percent CI 0.69-0.81) with invitation to screening and 38 percent (RR=0.62, 95 percent CI 0.56-0.69) for participation in screening. The pooled outcomes based on the CC studies were quite consistent, showing a reduction in women invited of 31 percent (odds ratio [OR]=0.69, 95 percent CI 0.57-0.83), whilst the relative reduction for women who actually participated in screening, adjusted for self-selection, was 48 percent (OR=0.52, 95 percent CI 0.42-0.65).

Conclusion: The most valid observational designs are those where longitudinal individual data are available, directly linking a woman's screening history to her cause of death. The results of such studies indicate that the best "European" estimate for the impact of mammographic population-based service screening programmes is a 25 to 31 percent reduction in breast cancer mortality for women invited for screening and a 38 to 48 percent reduction for women actually screened with sufficient follow-up time. Much of the current controversy surrounding the impact of breast cancer screening is due to the use of inappropriate methodological approaches unable to capture the true effect of mammographic screening.

A comparison of statistical methods for estimating the cumulative false-positive risk of a cancer screening program

Hubbard RA, Miglioretti DL

Group Health Research Institute, Seattle, Washington, United States

Background: False-positive test results are among the most common harms of cancer screening and may lead to more invasive and expensive diagnostic testing procedures. Estimating the cumulative risk of a false-positive result for a screening program consisting of repeat screening examinations is important for evaluating the long-term harms of screening. Commonly used statistical methods for estimating the cumulative false-positive risk rely on unrealistic assumptions that can lead to estimates that substantially over- or underestimate the true risk. We have developed a new semi-parametric statistical method that does not rely on assumptions used by previous approaches and gives unbiased estimates of the cumulative false-positive risk under a variety of observation schemes.

We aimed to introduce a semi-parametric estimator for the cumulative false-positive risk and to compare the performance of new and existing statistical methods using data on screening mammography from the Breast Cancer Surveillance Consortium.

Methods: We conducted a simulation study to compare performance of estimators for the cumulative false-positive risk under a variety of observation schemes. For each statistical method we estimated bias relative to the true cumulative false-positive risk and precision of the estimate. We then analyzed data from 240,683

mammograms from 129,588 women aged 40–59 collected by the Breast Cancer Surveillance Consortium between 1994 and 2007. We compared three existing statistical methods and our newly proposed method for estimating the cumulative false-positive risk after 10 years of annual screening mammography.

Results: Our simulation studies demonstrated that our newly developed semi-parametric method eliminated the bias observed for existing methods with little loss of precision. Using existing methods, estimates of the false-positive risk after 10 years of annual screening mammography for women with heterogeneously dense breasts ranged from 59 to 77 percent. Our semi-parametric approach estimated the risk to be 62 percent.

Conclusion: The semi-parametric estimator provides the best estimate of the false-positive risk individuals can expect to experience after participating in many years of repeat cancer screening. The substantial variability in estimates across statistical approaches highlights the importance of using appropriate statistical methodology in order to best inform decision makers of the harms of a cancer screening program.

Effectiveness of mammography screening of women aged 40–49 in groups based on risk factors for breast cancer

Hellquist BN[1], Nyström L[1], Czene K[2], Hjälm A[1], Jonsson H[1]

[1]Umeå University, Umeå, Sweden; [2]Karolinska institutet, Solna, Sweden

Background: There is no evidence whether effectiveness of mammography screening in relative terms differs between women with high or low breast cancer risk.

In the recent so-called Swedish Mammography Screening in Young Women (SCRY), mammography screening in age 40–49 in Sweden was shown to significantly reduce breast cancer mortality. The fact that about one-half of the 34 screening centres invited women from the age of 40 while the others invited from the age of 50 was utilized to form a study group and a control group that could be compared with respect to breast cancer mortality. The followup was 16 years on average, and the number of breast cancer deaths was 2,041.

The aim of the current study was to estimate effectiveness of screening in relative terms of young women with high or low breast cancer risk.

Methods: The SCRY data were split into risk groups based on the following factors: age at birth of first child, parity, and socioeconomic status. Data on breast cancer deaths were linked to the national Multigeneration Register and the Census (1980 and 1990) to retrieve information on the risk factors. Aggregated data from the same registers were used to adjust the person years in the total study and control groups for possible imbalance in the risk factors between the two groups. Risk group-specific rate ratios (RR) of screening effectiveness were calculated both for invited women and for participants versus control group.

Results: For parity and age at birth of first child, the screening effectiveness was largest for those with highest breast cancer risk. RR for women participating in screening was 0.53 (95% CI, 0.36-0.78), 0.65 (0.47- 0.89) and 0.78 (0.64-0.95) for women with 0, 1, and 2 children, respectively. For age at birth of first child, RR was 0.74 (0.52-1.06) and 0.78 (0.54-1.13) for women aged ≤19 and ≥30 respectively. For blue collar workers, RR was 0.80 (0.62-1.02), and for white collar workers, it was 0.73 (0.60-0.87). Similar results were observed when invitation was considered as exposure (not shown).

Conclusion: For women aged 40–49, a trend toward a larger mortality reduction for women with higher breast cancer risk due to parity was observed. The mortality reduction due to participation in screening was higher in white collar workers than in blue collar workers.

Harms of screening mammography in Japanese women as compared with American women

Ohuchi N[1], Kasahara Y[2], Kawai M[1]

[1]Tohoku University Graduate School of Medicine, Sendai, Japan; [2]Fukui Saiseikai Hospital, Fukui, Japan

Background: In Japan, screening mammography was endorsed in 2000 for women aged 50 years and over and was expanded to cover women aged 40–49 years in 2004, since the breast cancer incidence is the highest in women aged 40–49. The United States Preventative Services Task Force assessed the efficacy of breast cancer screening by the sum of its benefits and harms and recommends against routine screening mammography because of its relatively great harms for women aged 40–49 years. Assessment of the efficacy of screening mammography should take into consideration not only its benefits but also its harms, but data regarding those harms are lacking for Japanese women.

Methods: Therefore, we collected screening mammography data from 144,848 participants from 5 Japanese prefectures by age bracket (40–49, 50–59, 60–69, and 70 years or over) to assess the harms, including false-positive results, performance of unnecessary additional imaging, fine-needle aspiration cytology (FNA), and biopsy and its procedures. Differences in the recall rate, response rate, cancer yields, positive predictive values, false positives, additional imaging (screening mammography, ultrasound), FNA, and biopsy between ages 40–49 years and the other age brackets were statistically evaluated using the chi-square test. The Japanese data and BCSC data on the harms were also comparatively analyzed. Differences were regarded as significant if the two-sided P value was less than 0.05.

Results: The rate of cancer detected in women aged 40–49 years was 0.28 percent. The false-positive rate (9.6 percent) and rates of additional imaging by mammography (5.8 percent) and ultrasound (7.3 percent) were higher in women aged 40–49 years than in the other age brackets. The rates of FNA (1.6 percent) and biopsy (0.7 percent) were also highest in women aged 40–49. However, they seemed to be lower than the rates reported by the Breast Cancer Surveillance Consortium (BCSC) and other studies in the United States.

Conclusion: We conclude that the major harms, consisting of false-positive results, unnecessary additional imaging, and the need for biopsy and its invasiveness, are greatest in women in their 40s undergoing breast cancer screening mammography in Japan, but they seemed to be less than those reported by the BCSC and other studies in the United States. In the future, it will be necessary to compile more data regarding the mortality reduction and the accompanying harms in order to prove the efficacy of screening mammography in Japanese women aged 40–49.

A mathematical modeling framework to personalize mammography screening

Alagoz O[1], Ayer T[2], Stout NK[3]

[1]University of Wisconsin-Madison, Madison, Wisconsin, United States; [2]Georgia Institute of Technology, Atlanta, Georgia, United States; [3]Harvard Medical School, Boston, Massachusetts, United States

Background: Although mammography is the most commonly used modality for breast cancer screening and diagnosis, it has several potential risks, including high false positive rates, which are not very rare. Therefore, the balance of benefits and risks, which depend on personal risk factors as well as prior breast cancer screening history, is critical in designing a mammography screening schedule. In contrast to prior research and existing guidelines, which consider population-based screening recommendations that consider only age in screening recommendations, we propose a personalized mammography screening policy. To individualize the mammography screening process, we propose to use the probability of cancer at a given age that is based on the prior screening history and personal risk factors of women.

Methods: We develop an advanced decision-analytical model—finite-horizon partially observable Markov decision process (POMDP)—that utilizes the probability of cancer estimation for given breast cancer risk factors to optimize breast cancer screening. Our POMDP model incorporates two methods of detection (self or screen), age-specific unobservable disease progression, and age-specific mammography test characteristics. We use a validated micro-simulation model that was developed as part of National Cancer Institute's Cancer Intervention and

Surveillance Modeling Network (CISNET) program to estimate the parameters and solve this POMDP model optimally for individual patients.

Results: We find that our proposed personalized screening schedules outperform the existing guidelines with respect to the total expected quality-adjusted life years, while significantly decreasing the number of mammograms. We further find that the probability of cancer threshold beyond which a woman should undergo mammography screening increases with age. In addition, we show that self-detection (a combination of breast self-exam and clinical breast exam) is useful in increasing the total expected quality-adjusted life years.

Conclusion: A personalized optimal mammography screening strategy based on the probability of cancer at a given age, which accounts for personal risk characteristics and personal history of screening, outperforms age-based screening recommendations that are currently in use. Our proposed statistic, probability of cancer at a given age, can be used to simplify the implementation of risk-based screening practices.

Increased risk of breast cancer in women with false-positive test: Misclassification only?

von Euler-Chelpin M[1], Kuchiki M[2], Vejborg I[2]

[1]University of Copenhagen, Copenhagen, Denmark; [2]Rigshospitalet, University Hospital Copenhagen, Copenhagen, Denmark

Background: Screening for disease in healthy people inevitably leads to some false-positive tests. A recent study (von Euler-Chelpin, et al, *JNCI,* in press) showed that women with a false-positive test from screening with mammography had an increased risk of being diagnosed with breast cancer later in life as compared to women with only negative results (RR = 1.67 (95 percent CI 1.45 to 1.88). The relative risk remained significantly increased 6 or more years after the false-positive test. When stratified by assessment technology phase and using equal follow-up time, the false-positive group from the mid-1990s had a significantly higher risk of breast cancer (RR = 1.65, 95 percent CI = 1.22 to 2.24) than the group with negative tests, whereas the false-positive group from the early 2000s did not significantly differ from the group tested negative, (RR = 1.31, 95 percent CI = 0.87 to 2.00). However, whether this increased risk can be attributed to misclassification only, or to some other characteristics of the population, remains unknown.

Method: We used data from a long-standing, population-based screening mammography program in Copenhagen, Denmark, and studied the 296 women exposed to a false-positive test who later developed breast cancer, with regard to whether the cancer developed in the same breast or same location as the finding that initially caused the recall. Density and time from false-positive test to diagnosis were also taken into consideration.

Results: In 56 percent of the cases, the cancer had developed in a clearly different location than the findings that initially caused the recall (Group 1). In 23 percent of the cases, the cancer decidedly had developed in the same locations as the initial recall (Group 2). In 14 percent of the cases the cancer developed in the same breast, but whether it was in the same location could not be established (Group 3). The time from false-positive test to diagnosis ranged from approximately 0.5 to 15 years in all 3 groups, but average time from test result to diagnosis was 7.5 years in Group 1, 4.0 years in Group 2, and 8.4 years in Group 3. Group 1 had a significantly higher proportion of high-density breasts (BI-RADS3 and 4) than Group 2 ($p = 0.04$).

Conclusion: The results indicate that the increased risk cannot only be attributed to misclassification. The time from test result to diagnosis differs between the three groups, as does the density. In-depth study into the increased risk after false-positive test is warranted.

Evaluation of mammography screening — Why have epidemiological virtues been forgotten?

Lynge E

University of Copenhagen, Copenhagen, Denmark

It is part of classic epidemiology to distinguish between descriptive and analytical epidemiology. Descriptive epidemiology includes cross-sectional tabulations, time trends, geographical patterns, etc. The purpose of descriptive epidemiology is to quantify the disease burden and to generate hypotheses about disease etiology. Analytical epidemiology includes cohort and case-control studies. The purpose of analytical epidemiology is to assess the association between a given exposure (the independent variable) and a given health outcome (the dependent variable).

The purpose of mammography screening is to decrease breast cancer mortality. The effect of mammography screening has been evaluated in a number of randomized controlled trials. However, these trials were undertaken some years ago, and it is important to know whether mammography screening performs equally well in routine health care. Therefore, observational studies of mammography screening are pertinent.

In this evaluation, mammography screening is the exposure and breast cancer mortality is the health outcome. Cohort or case-control studies should preferably be used to assess the association between these two variables. This has also been done in a number of studies typically showing a 25% decrease in breast cancer mortality in women offered screening as compared to women not offered screening.

However, more recently time trend studies have been used also to evaluate the association between mammography screening and breast cancer mortality. These studies have typically concluded that there was no or limited impact of mammography screening on breast cancer mortality. So, here the descriptive epidemiology approach has replaced the analytical one. This comes with the expected limitations as for instance use of fixed age-groups instead of cohorts, etc. But the interesting point is that this new wave of descriptive studies has been published in quite high impact journals.

So, what is going on here? Has analytical epidemiology become so complicated that the scientific community has given up on it and “regressed” to rely on descriptive data? Or does this new wave reflect a skepticism toward health interventions? The presentation will address these questions based on examples from the recent literature on mammography screening.

Evaluating New Technologies and Their Readiness for Incorporation into Organized Screening Programs (Breast)

The Breast Imaging Reporting and Data System (BI-RADS) in the Dutch breast cancer screening programme: Its potential role as a stratification tool

Timmers J[1], van Doorne-Nagtegaal HJ[2], Zonderland HM[3], van Tinteren H[2], Visser O[2], Verbeek ALM[4], den Heeten GJ[1], Broeders MJM[1]

[1]National Expert and Training Centre for Breast Cancer Screening, Nijmegen, The Netherlands; [2]Comprehensive Cancer Centre The Netherlands (IKNL), Amsterdam, The Netherlands; [3]Academic Medical Centre, Amsterdam, The Netherlands; [4]Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

Background: The Breast Imaging Reporting and Data System (BI-RADS) differentiates between cases with a high (BI-RADS 4 or 5) or low suspicion (BI-RADS 0) for malignancy; it provides knowledge of the chance of malignancy and can thus determine type of further assessment. The aim of this study is to assess the suitability of BI-RADS as a stratification tool in the typical Dutch screening setting, where assessment is organised in hospital setting outside the screening programme.

Methods: Data of 93,793 screened women in the Amsterdam screening region (November 2005–July 2006) were reviewed. BI-RADS categories, work-up, age, final diagnosis, and final TNM classification were available from the screening registry. Interval cancers were obtained through linkage with the cancer registry. BI-RADS was introduced as a pilot in the Amsterdam region before the nationwide introduction of digital mammography (2009–2010).

Results: 1559 women were referred to hospital (recall rate 1.7 percent). Breast cancer was diagnosed in 485 women (detection rate 5.2 per 1,000). BI-RADS 0 (more information required) had a lower positive predictive value (PPV, 14.1 percent) than BI-RADS 4 (suspect but not typical for malignancy, 39.1 percent) and BI-RADS 5 (highly suspicious for malignancy, 92.9 percent; $P<0.0001$). The number of procedures with imaging alone, invasive procedures, and tumour size also differed significantly between BI-RADS categories ($P<0.0001$).

Conclusion: In conclusion, the significant differences we found in PPV, invasive procedures, and tumour size match with stratification into BI-RADS categories and thus represent the radiologists' degree of suspicion for malignancy. Currently, diagnostic workup is not part of the Dutch screening programme. All women, regardless of the suspicion for malignancy, are recalled for full hospital assessment. Our study shows that the BI-RADS 0 cases can be assessed separately from the BI-RADS 4 or 5 cases, for instance along a "quick assessment route." At present, a large multicenter trial is performed to study the cost effectiveness of such a strategy. Hospital management and policy makers should then consider reviewing current policies to reduce waiting times, costs, and anxiety.

Performance of digital compared to screen film mammography in concurrent cohorts within the Ontario Breast Screening Program

Chiarelli AM[1,2], Edwards SA[1,2], Muradali D[1], Shumak RS[1], Majpruz V[1], Done SJ[3], Brown P[1,2], Yaffe MJ[4]

[1]Cancer Care Ontario, Toronto, Ontario, Canada; [2]University of Toronto Dalla Lana School of Public Heath, Toronto, Ontario, Canada; [3]Campbell Family Institute for Breast Cancer Research, University Health Network, Toronto, Ontario, Canada; [4]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

Background: The Ontario Breast Screening Program (OBSP) has offered screen film mammography (SFM) since 1990 and introduced digital mammography (DM) in 2006. Since 64 (43.8 percent) of the 146 OBSP screening centres provided DM between 2008 and 2009, performance measures can be compared in concurrent cohorts. As

the digital units are either direct-radiography (DR) or cassette-based radiography (CR) systems, performance measures can be further examined by type of digital unit.

This study aimed to compare screening performance measures (recall rate, cancer detection rate, and positive predictive value) between women screened by DM (CR) or DM (DR) and SFM and to compare risk factors and tumour characteristics among women diagnosed with invasive breast cancer.

Methods: This study identified concurrent cohorts of women 50 to 74 years of age screened between January 1, 2008, and December 31, 2009, and followed for 12 months to either their next screening visit or breast cancer diagnosis. One cohort was screened by DM (DR) (254,919) or DM (CR) (74,203) and the other by SFM (487,481). Performance measures and approximate 95 percent confidence intervals (CI) calculated for binomial proportions were compared between the cohorts from information routinely collected from OBSP. Information on risk factors collected by a telephone administered questionnaire and tumour characteristics abstracted from pathology reports will be compared for eligible women (2,461) diagnosed with invasive breast cancer between the cohorts.

Results: The recall rate was similar for DM (DR) (7.7 percent, 95 percent CI 7.6-7.8) but significantly lower for DM (CR) (6.6 percent, 95 percent CI 6.5-6.8) than SFM (7.4 percent, 95 percent CI 7.3-7.5). The cancer detection rate was similar for DM (DR) (4.9 per 1000, 95 percent CI 4.7-5.2) and SFM (4.8 per 1000, 95 percent CI 4.7-5.2), however was significantly lower for DM (CR) (3.4 per 1000, 95 percent CI 3.0-3.9). The positive predictive value was also significantly lower for DM (CR) (5.2 percent, 95 percent CI 4.7-5.8) compared to SFM (6.6 percent, 95 percent CI 6.4-7.0). For the 1,047 women with completed interviews and pathology information, no significant differences in breast cancer risk factors or tumour characteristics were found between the cohorts.

Conclusion: Preliminary analyses found lower cancer detection rates and positive predictive values for DM (CR) compared to SFM. These associations will be further examined in multivariate analyses adjusting for age, family history, current estrogen use, type of screen (initial or subsequent), density, and average centre volume while controlling for clustering by centre and radiologist.

BIEMR: The Breast Imaging EMR

Abdolell M[1], Doyle G[2], Payne JI[1], Foley T[3], Caines JS[1,3], Duggan R[3], Barrington G[2]

[1]Dalhousie University, Halifax, Nova Scotia, Canada; [2]Breast Screening Program of Newfoundland and Labrador, St. John's, Newfoundland and Labrador, Canada; [3]Nova Scotia Breast Screening Program, Halifax, Nova Scotia, Canada

Background: Organized breast screening programs (BSPs) in Canada were first established in the 1980s, and information systems developed during this time continue to be used today. The Breast Health Data Infrastructure Initiative (BHDII), an interprovincial collaboration between clinicians, breast screening program directors, and academics, has led the development of the Breast Imaging Electronic Medical Record (BIEMR). BIEMR is an information system that satisfies the unique clinical needs of mammographers and the various reporting and surveillance needs of BSPs in a way that proprietary information systems cannot.

Methods: BIEMR leverages the strengths of Open Source Software (OSS) including CAISIS (an integrated clinical and research management system), the R language for statistical computing, and the LaTeX document preparation system. BIEMR features chronologically displayed records of clinical encounters; tools for appointment scheduling and recalls (e.g., auto-generated reminder letters); modules for radiological reporting, patient management, clinical rounds, synoptic breast pathology reporting, and teaching; and Web-based eForms for clinical documentation. BIEMR provides automated reporting (e.g., wait times) and supports integration with local Picture Archiving and Communications System (PACS).

A unified process model was utilized to outline data elements, processes, and current functionality of the Mammography Information Systems (MIS) in Nova Scotia and Newfoundland and Labrador. Similar items were merged while unique items were either maintained or removed. The BIEMR development committee took direction from the BHDII for prioritizing development and system features.

Results: BIEMR replaces the current MIS in the provinces of Nova Scotia and Newfoundland and Labrador and the Northwest Territories. Clinical users include radiologists, nurses, technologists, and booking clerks. Other provincial BSPs have shown interest in adopting BIEMR. BIEMR will interface with other Hospital Information Systems.

BIEMR is available free of charge to any organization searching for a robust, cost-effective solution to clinical and administrative data management for breast screening. A Community of Practice will be established to foster the adoption and growth of BIEMR. Collaboration with the CAISIS community will also prove essential for reaching shared goals for development and leveraging experienced resources.

Conclusion: BIEMR supports patient management and system level surveillance. The breadth of the community involved in development of the system and the transparency of the development process conform to the HIMSS standard of openness. BIEMR sets the standard for synoptic radiological reporting and enables data to be readily collected, accessed, analyzed, interpreted, and disseminated. It lowers the barrier for establishing organized BSPs in low-resource settings.

AutoDensity: An epidemiologically validated automated method for measuring mammographic breast density from digitised screening mammograms

Nickson C[1], Arzhaeva Y[2], Aitken Z[1], Elgindy T[2], Buckley M[2], Li M[1], English D[1], Kavanagh A[1]

[1]The University of Melbourne, Carlton, Victoria, Australia; [2]Centre for Mathematics, Informatics, and Statistics, Center for Scientific and Industrial Research Organisation, North Ryde, New South Wales, Australia

Background: High mammographic breast density is associated with breast cancer risk. In screening programs, it is also associated with low program sensitivity, high interval cancer rates, and larger tumours at diagnosis. Accurate, routine measurement of breast density by population screening programs would enable monitoring of screening performance for women with high breast density against changes in technologies and clinical practices and in future enable personalised screening strategies according to breast density such as tailored screening intervals, ultrasound, or magnetic resonance imaging. We aim to identify fully automated methods for measuring breast density from screening mammograms (*AutoDensity* measures) that equal or improve on a popular computer-assisted method (Cumulus) in terms of predicting breast cancer risk and screening program performance.

Methods: Our dataset comprised clinical and screening data and digitised film mammograms from BreastScreen Australia for 984 women with screen-detected cancers, 367 women with interval cancers, and 4,975 controls. Cumulus breast density had been measured from this dataset for a previous study, with 88.6 percent inter-reader reliability. We devised a method to automatically segment the breast area from background information and compared this to breast segmentation using Cumulus. We tested several image processing algorithms to characterise the dense breast tissue within the breast area, by comparing their performance against Cumulus in epidemiological risk models accounting for age and hormone therapy use, for example.

Results: *AutoDensity* and Cumulus breast segmentation was highly correlated (98 percent, $p<0.001$). The optimal *AutoDensity* breast density measure predicted cancer risk and screening outcomes at least as well as Cumulus. For example, by *AutoDensity*, women in the highest decile of breast density compared to the lowest quintile were at higher risk of invasive breast cancer (OR=3.2, 95 percent CI 2.5-4.1), large (>15mm width) screen-detected cancers (OR=6.4, 95 percent CI 3.7-11.1), and interval cancers (OR=4.8, 95 percent CI 3.1-7.4). Using Cumulus, these figures were: risk of invasive breast cancer OR=2.4, (95 percent CI 1.9-3.1), large screen-detected cancers OR=6.6 (95 percent CI 3.7-11.6), and interval cancers OR=4.1 (95 percent CI 2.6-6.4).

Conclusion: *AutoDensity* measurement of breast density from digitised screening mammograms equals or improves on Cumulus in terms of identifying screened women at higher risk of invasive breast cancer, interval cancers, and larger cancers at diagnosis, after accounting for age and hormone replacement therapy use. AutoDensity measures are immediately suitable for research involving film mammograms. To adapt these tools to digital mammography, we are currently applying the same testing and validation approach to a large dataset of digital BreastScreen Australia screening mammograms and associated screening and clinical data.

Radiation doses in full field digital and screen film mammography

Hauge IHR[1], Hofvind SSH[1,2]

[1]Oslo and Akershus University College of Applied Sciences, Oslo, Norway; [2]Cancer Registry of Norway, Oslo, Norway

Background: Full Field Digital Mammography (FFDM) gradually replaced Screen Film Mammography (SFM) in the Norwegian Breast Cancer Screening Programme (NBCSP) during the period 2000–2011. Easier work flow and dose savings are the main reasons for the change. We aimed to analyze the extent of the dose savings by changing from SFM to FFDM.

Methods: Exposure data from SFM and FFDM were collected during the time period 2006–2008 (SFM: n=24 FFDM: n=7) and in 2011 (FFDM: n=26). Mean glandular doses (MGDs) were estimated based on the collected exposure factors. The MGD per exposure is estimated based on the reported exposure factors from each of the women attending screening and a model published by Dance et al. based on Monte Carlo simulations:

MGD=K_(c,air) gcs (1)

Here Kc,air is the entrance surface air kerma without backscatter, g is the incident air kerma to MGD conversion factor for breasts with 50 percent glandularity, c corrects for differences in breast composition from 50 percent glandularity, and s corrects for other target/filter combinations different from the target/filter combination molybdenum/molybdenum, for which s equals 1.000. The s-factors used are listed in Dance et al. (1990, 2000). The g-factor is based on Monte Carlo simulations.

Result: The average MGD was significantly lower for FFDM compared to SFM (craniocaudal (CC): 1.19±0.03 mGy versus 1.33±0.02 mGy, respectively, mediolateral oblique (MLO): 1.27±0.03 mGy versus 1.45±0.03 mGy, respectively). However, some FFDM units provided higher doses than the SFM units. Average MGD per exposure varied substantially between the screening units, sorted by manufacturer/model, and varied more for FFDM units than for SFM units. The repeated dose measurements performed in 2011, when all SFM units had been replaced by FFDM units, resulted in similar variation and confirmed substantial distinctions between the different manufacturers/models.

Conclusion: The difference in dose for the different units and also the difference in dose for the same model/manufacturer call for the need to check the image quality. The hypothesis would be that the image quality is sufficient, but it might still be that the unit can be optimized in order to improve the performance of the unit.

When estimating risk of radiation-induced breast cancer from mammographic screening, an average MGD can be applied. We will be applying the dose estimate from the FFDM units, but will also compare the dose-risk of doses from SFM units and the range in MGD between the units.

Benefits, Harms and Costs of Cancer Screening Programs/Factors Influencing Policy and Decision Making (Other Cancer Sites)

Randomized trial comparing three methods of values clarification for decision making about CRC screening in U.S. and Australian men and women

Howard K[1], Lewis C[2], Sheridan S[2], Crutchfield T[2], Hawley S[3], Brenner A[4], Pignone M[2]

[1]University of Sydney School of Public Health, Sydney, New South Wales, Australia; [2]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States; [3]University of Michigan, Ann Arbor, Michigan, United States; [4]University of Washington School of Public Health, Seattle, Washington, United States

Background: Consensus recommendations advocate using values clarification methods within decision aids, but the effects of different methods have not been well studied. We sought to compare the effects of three methods of values clarification: balance sheet; rating and ranking; and a discrete choice experiment on decision making about colorectal (CRC) screening.

Methods: We performed a randomized trial of the three methods of values clarification. Eligible participants were adults ages 50–75 with no prior personal or family history of CRC or personal history of adenomas. They were recruited from online panels managed by a survey research organization in the United States and Australia. Those eligible were randomized to one of the three values clarification techniques (balance sheet, rating and ranking, or discrete choice experiment [DCE]) and completed pre- and post-task questionnaires. In each group, participants viewed information about CRC and CRC screening, including information on five key attributes of screening tests: reduction in risk of CRC incidence and mortality; nature of the test; screening frequency; complications from screening; and chance of requiring a colonoscopy (as initial or follow-up testing). Main outcomes were the self-reported most important screening attribute and unlabeled screening test preference, each assessed on a post-task questionnaire.

Results: Nine hundred twenty participants were enrolled; mean age was 59.0; 87.0 percent were white; 34.2 percent had completed a 4-year college degree; 42.8 percent had household incomes less than $45,000 per year; and 44.9 percent were up to date with CRC screening.

Most important attribute differed across groups: those assigned to rating and ranking were significantly more likely to choose risk reduction as the most important attribute (69.8 percent) compared with those assigned to balance sheet (54.7 percent) or DCE (49.3 percent), $p < 0.0001$, these did not vary by country ($p=0.236$). Fecal occult blood test (FOBT) was the most frequently preferred testing strategy overall (55.9 percent); Australians were more likely to prefer FOBT (Australia's 66.2 percent versus United States' 45.1 percent, OR 2.4, 95 percent CI 1.8, 3.1). Few participants favored no screening (United States: 9.2 percent, Australia: 6.2 percent).

Conclusion: Attribute importance varied by values clarification task but not by country. Preferences for screening were high in both countries, with Australians being somewhat more likely to prefer FOBT compared with other modalities. Based on patient preferences, screening programs should incorporate multiple screening options.

Preferences for recommendation level in colorectal cancer screening: A population-based survey in Great Britain

Waller J[1], Macedo A[1], von Wagner C[1], Simon A[1], Jones C[1], Wardle J[1], Hammersley V[2], Weller D[2], Campbell C[2]

[1]University College London, London, United Kingdom; [2]The University of Edinburgh, Edinburgh, United Kingdom

Background: A tension exists between maximising coverage and promoting individual autonomy in cancer screening programmes. Little is known about the extent to which the general public wants to engage in the process of "informed choice" in screening and whether they would like to receive a recommendation to participate

from the programme organisers. The aim of this study is to explore public preferences for a recommendation in colorectal cancer screening and test the prediction that preference for a recommendation would be associated with demographic characteristics, information preferences, trust in the National Health Service (NHS), and previous screening uptake.

Setting: A population-based survey of British adults in 2011.

Sample: Men and women aged 50 to 80 years living in England (n=1738), Scotland (n=217), and Wales (n=112).

Methods: Participants were recruited as part of a TNS Research International survey and took part in home-based computer-assisted interviews. The outcome measure was preferred level of recommendation to participate in cancer screening: (1) a strong recommendation to participate; (2) consider an offer (recommendation + information to support decision-making); and (3) information for decision-making only, no recommendation one way or the other. Other measures included: (i) demographic characteristics; (ii) preferences for information about benefits and risks of screening; (iii) trust in the NHS; and (iv) past screening behaviour.

Results: The majority (84 percent) of respondents expressed a preference for at least some level of recommendation from the NHS with their screening invitation; 16 percent did not. Men were more likely than women to want some form of recommendation to attend screening, but there were no differences by age, social grade, country of residence, marital status, or experience of cancer. Most respondents reported high levels of trust in the NHS regarding cancer screening tests. Transparency about risks and benefits was highly valued, regardless of respondents' level of trust in the NHS. Attention to information in the screening leaflet and previous participation in faecal occult blood test screening were significant predictors of recommendation preferences.

Conclusion: Exploring public preferences for communication in cancer screening may help inform policy and future research. In the United Kingdom, the majority of the public want to receive a recommendation from the NHS to attend screening but also value provision of balanced information about risks and benefits. Public preferences for levels of recommendation in other countries with organised cancer screening programmes should be explored.

Randomized comparison of organized FIT invitation, organized colonoscopy invitation, and usual care for colorectal cancer among the underserved

Gupta S[1], Hammons M[2], Valdez L[2], Carter E[3], Koch M[1], Tong L[1], Ahn C[1], Rockey D[1], Tiro J[1], Halm EA[1], Skinner SS[1]

[1]University of Texas Southwestern Medical Center, Dallas, Texas, United States; [2]Moncrief Cancer Institute, Dallas, Texas, United States; [3]John Peter Smith Health System, Fort Worth, Texas, United States

Introduction: Screening may prevent colorectal cancer (CRC) mortality, but participation remains suboptimal in the United States, particularly among the underserved such as individuals without health insurance and access to primary care. Optimal approaches to boost screening, including best test(s) to offer, are unknown. In a diverse population of patients served by John Peter Smith Hospital (JPS), the primary health system for underserved patients in Tarrant County, Texas, United States, we conducted a three-arm randomized controlled trial (RCT) with the following aims: (1) compare organized mailed invitation to use/return a one-sample fecal immunochemical test (FIT) versus organized mailed invitation to colonoscopy; (2) compare organized invitations versus usual care; and (3) assess the comparative costs of interventions.

Methods: Patients aged 55 to 64 years who were not up-to-date with screening and uninsured except for participation in a JPS medical assistance program for the underserved were eligible. Patients were randomly assigned to: (1) mailed invitation to FIT screening, with a FIT kit included; (2) mailed invitation to colonoscopy screening; or (3) usual care. Usual care consisted of participation in the JPS medical assistance program which allows medical care access, including opportunistic, visit-based offers for CRC screening at the primary provider's discretion; intervention groups also received usual care. We used phone calls to promote screening, assist with test scheduling, and facilitate abnormal test follow up. Primary outcome was screening participation at 1 year.

Secondary outcomes included neoplasia detection and program costs. A waiver of informed consent was obtained for the RCT.

Results: We assigned 5,996 patients to organized FIT (n=1,600), organized colonoscopy (n=480), or usual care (n=3,916) groups. Sex/race across groups were similar: overall 64 percent were female; 41 percent Caucasian, 24 percent African American, 29 percent Hispanic, and 7 percent other race/ethnicity. Interim analysis for the 2,080 patients assigned to organized invitation demonstrated a screening rate of 33 percent for the FIT group (532/1,600) and 14 percent for the colonoscopy group (69/480). Among patients receiving organized invitation, we identified 4 patients with cancer (3/FIT and 1/colonoscopy group), 21 with advanced adenoma (13/FIT and 8/colonoscopy group), and 39 with non-advanced adenoma (16/FIT and 23/colonoscopy group). Analyses comparing outcomes across all 3 RCT arms—including benefits, harms, and costs—are ongoing.

Conclusion: Early results from our RCT of organized invitation approaches to optimize CRC screening for the underserved show substantially higher rates of screening rates among patients offered screening with organized FIT versus organized colonoscopy.

The consequences of overuse of screening colonoscopy for U.S. Medicare beneficiaries: A modeling study

van Hees F[1], Zauber AG[2], Klabunde CN[3], Lansdorp-Vogelaar I[1], van Ballegooijen M[1]

[1]Erasmus Medical Center, Rotterdam, The Netherlands; [2]Memorial Sloan-Kettering Cancer Center, New York, New York, United States; [3]National Cancer Institute, Bethesda, Maryland, United States

Background: Many Medicare beneficiaries (i.e., United States citizens aged 65 or older) receive repeated screening colonoscopies more frequently than guidelines recommend or continue to be screened up to very advanced age. Both practices increase the likelihood that a beneficiary will benefit from screening. However, they also increase the number of colonoscopies a beneficiary has to undergo and, hence, the probability of experiencing an adverse event. Greater insight into the balance of the added benefits and the added burden and harms associated with overuse of screening colonoscopy amongst Medicare beneficiaries is needed.

Methods: We used a state-of-the-art micro-simulation model for colorectal cancer (MISCAN-colon) to quantify the benefits (number of life-years gained (LYGs)), burden (number of colonoscopies undergone), and harms (number of adverse events experienced) associated with colonoscopic screening of previously unscreened 65-year-olds at ages 65 and 75 (scenario without overuse). Subsequently, we quantified the benefits, burden, and harms associated with scenarios in which screening was performed more frequently than recommended (every 5 or 3 years) or in which screening was continued up to more advanced age (85 or 95) (overuse scenarios). This allowed us to calculate the additional number of colonoscopies performed per additional LYG (burden versus benefits) and the additional number of adverse events experienced per additional LYG (harms versus benefits) associated with overuse of screening colonoscopy.

Results: Compared to no screening, colonoscopic screening of 1,000 previously unscreened 65-year-olds at ages 65 and 75 resulted in 142 LYGs, which came at a cost of 2,823 colonoscopies and 16.7 adverse events; hence, per LYG 20 colonoscopies were performed and 0.12 adverse events were experienced. Per additional LYG by screening every 5 instead of 10 (3 instead of 5) years, 115 (352) additional colonoscopies were performed and 0.20 (0.42) additional adverse events were experienced. Per additional LYG by screening up to age 85 instead of 75 years, 726 additional colonoscopies were performed and 4.56 additional adverse events were experienced. Further continuation of screening did not add LYGs.

Overuse amongst previously screened Medicare beneficiaries resulted in even more unfavorable balances among benefits, burden, and harms.

Conclusions: The balance between the added benefits and the added burden and harms associated with screening Medicare beneficiaries with colonoscopy more frequently than guidelines recommend or up to very advanced age

is unfavorable. There is need for interventions and/or incentives to discourage overuse of screening colonoscopy in this population.

Colorectal cancer screening program in the Ontario population: Additional effects of identifying individuals with an increased risk

Goede SL[1], Rabeneck L[2], Lansdorp-Vogelaar I[1], Zauber AG[3], Paszat LF[4], Hoch JS[2], Yong JHE[2], van Ballegooijen M[1]

[1]Erasmus Medical Center, Rotterdam, The Netherlands; [2]Cancer Care Ontario, Toronto, Ontario, Canada; [3]Memorial Sloan-Kettering Cancer Center, New York, New York, United States; [4]Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

Background: In 2008 a population-based colorectal cancer (CRC) screening program was launched in Ontario, Canada. The program is set up to identify individuals in the general population with previously unknown increased family risk, defined as having one or more first-degree relatives diagnosed with the disease. Once identified, such individuals are offered colonoscopy screening. Other individuals are offered guaiac-based fecal occult blood test (gFOBT) screening. The aim of this study was to estimate the added health benefits of this stratified screening approach as compared to a situation without risk identification in which gFOBT screening would be offered.

Methods: We used a microsimulation model to simulate the Ontario population of 50 years and older in 2008. We assumed that 10 percent of the population was on average at two-fold increased risk of CRC compared to the general population, because of family history of CRC. Four different screening scenarios were considered: (1) no screening; (2) no program, screening behaviors as observed before the program (Frozen 2008); (3) gFOBT program screening without active risk stratification (No RiskStrat); (4) gFOBT program screening in which individuals at increased risk were offered colonoscopy (RiskStrat). Screening was offered between ages 50 and 74 for FOBT every 2 years and for colonoscopy every 10 years. It was assumed that the screening programs would increase screening adherence as presented in Table 1. For each scenario, annual CRC incidence and mortality were calculated from 2008 to 2038.

Results: In the program screening scenario without risk stratification (No RiskStrat), an incidence reduction of 2.9 percent compared to the Frozen 2008 scenario was achieved by the year 2038 (Figure 1). In the scenario with stratified screening approach (RiskStrat), this amounted to a 6.6 percent reduction. The effect of screening on CRC mortality was more pronounced; -6.0 percent and -10.1 percent, respectively, compared to the Frozen 2008 scenario (Figure 2).

Conclusion: Identification of individuals with such an increased risk that colonoscopy screening is recommended, often considered as a spin-off effect of a population based screening program, may in fact account for a substantial portion of the health benefits of the program.

Optimal ages to stop screening for breast, colorectal, and prostate cancer based on comorbidity

Lansdorp-Vogelaar I[1], Gulati R[2], Mariotto A[3], Schechter C[4], Heijnsdijk E[1], Knudsen AB[5], van Ravesteijn N[1], Wever E[1], van Ballegooijen M[1], Rutter CM[6], Kuntz KM[7], Feuer E[3], Etzioni R[8], Zauber AG[9], de Koning HJ[1], Mandelblatt J[10]

[1]Erasmus Medical Center, Rotterdam, the Netherlands; [2]Fred Hutchinson Cancer Research Center, Seattle, Washington, United States; [3]National Cancer Institute, Bethesda, Maryland, United States; [4]Yeshiva University, Albert Einstein College of Medicine, Bronx, New York, United States; [5]Massachusetts General Hospital, Boston, Massachusetts, United States; [6]Group Health Cooperative, Seattle, Washington, United States; [7]University of Minnesota, Minneapolis, Minnesota, United States; [8]Fred Hutchinson Cancer Research Center, Seattle, Washington, United States; [9]Memorial Sloan-Kettering Cancer Center, New York, New York, United States; [10]Georgetown University, Washington, District of Columbia, United States

Background: Population guidelines do not recommend routine cancer screening of individuals aged 75 and older, because the benefits are not thought to outweigh the harms in groups with limited life-expectancy. However, health of individuals is heterogeneous for this age group. This study aimed to determine the optimal age to stop screening for breast, colorectal, and prostate cancer based on an individual's comorbidity-specific life expectancy.

Methods: We used three well-established microsimulation models to estimate the baseline harms and benefits of biennial mammography, biennial PSA-testing, and 10-yearly colonoscopy until age 75 in the average population. Because harms are mostly proportional to the number of screen tests performed, we used the summary metric of number needed to screen to prevent one cancer death for this balance. Next, we used the models to estimate the balance between harms and benefits of several stopping ages by comorbidity status (none, low, moderate, and severe). Comorbidity-specific life expectancy was derived from an analysis of Medicare patients. The age to stop screening at each level of comorbidity was defined as the point when the balance of harms and benefits matched that of screening until age 75 in the average population.

Results: For all cancers, people with severe comorbidity already had 50–100 percent higher numbers needed to screen to prevent one cancer death at age 66 than the total average population at age 75. For people with moderate comorbidity, screening until age 70 for colorectal cancer, 72 for breast cancer, and 78 for prostate cancer yielded a similar balance between harms and benefits as screening the average population until age 75, while people with low comorbidities could be screened until age 70 for colorectal cancer, 78 for breast cancer, and 80 for prostate cancer to have the same balance. People without comorbidities could be screened up to age 80 for all cancers.

Conclusion: The three models quantify the impact of comorbidity on screening decisions. The results indicate that comorbidity is an important determinant of the balance between harms and benefits of screening. People with severe comorbidity should not be screened after age 65, while those without comorbidity could consider screening up to age 80.

Expenditure and resource utilisation for cervical screening in Australia

Lew J-B[1], Howard K[2], Gertig D[3], Smith M[1], Clements M[4,5], Nickson C[1,6], Shi J-F[1], Dyer S[2], Lord S[2], Creighton P[1,7], Kang Y-J[1], Tan J[8], Canfell K[1,2]

[1]Cancer Council New South Wales, Woolloomooloo, New South Wales, Australia; [2]University of Sydney, Sydney, New South Wales, Australia; [3]Victorian Cytology Service, Carlton, Victoria, Australia; [4]Australian National University, Canberra, Australian Capital Territory, Australia; [5]Karolinska Institutet, Stockholm, Sweden; [6]University of Melbourne, Melbourne, Victoria, Australia; [7]University of New South Wales, Sydney, New South Wales, Australia; [8]Royal Women's Hospital, Melbourne, Victoria, Australia

Background: The National Cervical Screening Program in Australia currently recommends that women ages 18 to 69 are screened with conventional cytology every 2 years. Publicly funded HPV vaccination was introduced in 2007, and partly as a consequence, a review of the screening recommendations has recently been announced. This study aimed to provide a baseline for such a review by quantifying screening program resource utilisation and costs in 2010.

Methods: A detailed model of current cervical screening practice in Australia was constructed; we used data from the Victorian Cervical Cytology Register to model age-specific compliance with screening and follow-up. The 2010 Australian female population was applied to modeled rate estimates to calculate costs and numbers of colposcopies, biopsies, treatments for precancer, and cervical cancers in that year, assuming that the numbers of these procedures were not yet substantially impacted by vaccination.

Results: The total cost of the screening program in 2010 (excluding administrative program overheads) was estimated to be AUD$194.2 million. A total of 1.7 million primary screening smears costing $92 million were estimated to have been conducted, a further 188,900 smears costing $15.3 million were conducted to follow-up low grade abnormalities, 70,900 colposcopies and 34,100 biopsies costing $21.2 million were performed, and

about 18,900 treatments for precancerous lesions were performed, associated with a cost of $45.3 million for treatment and post-treatment follow-up. We also estimated that $20.5 million (11 percent) of the total expenditure was associated with work-up and treatment for approximately 760 women who were predicted to be diagnosed with invasive cervical cancer in 2010. Overall, an estimated $23 for each adult woman in Australia is spent annually on screening program-related expenditure.

Conclusion: Approximately half of the total cost of the screening program is spent on delivery of primary screening tests; but the introduction of new technologies, increasing the interval and changing the age range of screening would all have a substantial impact on this expenditure, as well as having some impact on follow-up and management costs. These estimates provide a benchmark for future assessment of the impact of changes to screening program recommendations on the costs of cervical screening in Australia.

Cost-effectiveness and budget impact analysis of primary HPV screening in urban populations in China

Shi J-F[1, 2, 3], Canfell K[1,3], Lew J-B[1], Ma L[4], Walker R[1], Zhao F-H2, Xu M[1], Chen J-F[4], Smith MA[1], Wu R-F[5], Qiao Y-L[2]

[1]Cancer Council New South Wales, Woolloomooloo, New South Wales, Australia; [2]Cancer Institute, Chinese Academy of Medical Sciences, Beijing, People's Republic of China; [3]School of Public Health, University of Sydney, Sydney, New South Wales, Australia; [4]Dalian Medical University, Dalian, People's Republic of China; [5]Shenzhen Hospital of Beijing University, Shenzhen, People's Republic of China

Background: Most women in urban populations in China do not have access to cervical screening. The role of human papillomavirus (HPV) screening in low-resource urban women has not been clarified, nor has it been determined how this would interface with screening in higher resource subgroups.

This study aimed to (1) review population demographics to determine the most practical age to screen for cervical cancer in this setting and (2) quantify the outcomes and economic implications of a combined strategy involving infrequent HPV screening of low-resource subgroups and more intensive screening of women with the ability and willingness to pay.

Methods: (1) As an example of an urban population, we reviewed available census data for females in Shenzhen City in South China in 2000 and in 2005. (2) We used data from the *International Agency for Research on Cancer (IARC)* and Cancer Institute and Hospital, Chinese Academy of Medical Sciences field studies in Shenzhen to support modelling of sexual behaviour, screening, and diagnostic processes. We modeled the following combined population scenarios: (a) once-lifetime HPV screening in young factory workers (who compose approximately 50 percent of the population in Shenzhen; these are predominantly younger women, many of whom are recent immigrants from rural areas); (b) once- or twice-lifetime or 6-yearly HPV screening in the remaining majority (general) population age 30 to 59 (assumed to be 45 percent); (c) 6-yearly screening or at IARC-recommended intervals using a comprehensive screening protocol in a small proportion of women who are willing to pay out-of-pocket expenses for screening (assumed to be 5 percent). We assessed cost-effectiveness and budget impact of these combined strategies using single and multiple cohort approaches, respectively.

Results: (1) Women ages 25 to 29 composed 33 percent (2005) to 44 percent (2000) of females in Shenzhen, implying a very high rate of rural migration of young women into the city, with many women leaving in their thirties. (2) The cost-effectiveness ratios for the various combined strategies varied between US$1,299–1,438 per life year saved compared to no intervention; this compares to a gross domestic product per capita in Shenzhen in 2009 of US$13,581. The total predicted expenditure on cervical screening from 2012 to 2032 varied from US$91.9–$146.8 million, depending on the particular combined strategy selected.

Conclusions: Large proportions of rural immigrant women would be missed unless they are screened by about 30 years; therefore a slightly younger screening start age of 25–29 years could be considered in cities with large populations of young factory workers. Cervical screening would be a very cost-effective intervention in this setting but would require considerable expenditure over the next 20 years.

Cervical Cancer incidence in Ontario women: Implications of differing sociodemographic gradients by morphologic type (adenocarcinoma versus squamous cell carcinoma)

Prummel M[1,2], Candido E[1], Elit L[3], Marrett LD[1]

[1]Cancer Care Ontario, Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada; [3]Juravinski Cancer Centre, Hamilton, Ontario, Canada

Background: While the incidence of squamous cell carcinoma of the cervix has been declining for some decades in Ontario (presumably due to widespread uptake of the Pap test), the incidence of adenocarcinoma has changed little. There is a considerable socioeconomic gradient related to use of the Pap test, with the highest rate of uptake in the richest income group. The objective of this work was to examine the sociodemographic characteristics associated with cervical cancer incidence in Ontario and to determine whether these differed by morphology.

Methods: Incident cases of cervical cancer diagnosed in 1991–2007 were obtained from the Ontario Cancer Registry (OCR). Population data and data on neighborhood characteristics, including income quintiles and urban or rural residence, were obtained from the Canadian Census (1991, 1996, 2001, and 2006). Using postal codes recorded at the date of diagnosis, individual cases were assigned to Enumeration or Dissemination Areas (EA/DA). Neighborhood characteristics from the census closest to diagnosis year were appended to each case by EA/DA. Age standardized incidence rates (ASIRs) and rate ratios with corresponding 95 percent confidence intervals were calculated. Analyses were conducted separately for adenocarcinoma (excluding adenosquamous) and squamous cell carcinoma.

Results: The cervical cancer incidence rate was 50 percent higher for women living in the poorest income quintile compared to the richest (RR=1.50, 95 percent CI=1.41, 1.61) and 11 percent higher among those in rural areas compared to urban (RR=1.11, 95 percent CI=1.05, 1.18). The incidence rate for squamous cell carcinoma, which accounts for 75 percent of cases, demonstrated similar associations with these factors, being higher in the poorest income quintile compared to the richest (RR=1.71, 95 percent CI= 1.58-1.86) and in rural areas compared to urban (RR=1.14, 95 percent CI= 1.05-1.22). Conversely, there was no income or geographic disparity observed for adenocarcinoma.

Conclusion: Income and urban/rural gradients for squamous cell carcinoma of the cervix mirror those observed for Pap test uptake. The lack of gradient for adenocarcinoma is consistent with the apparently poor performance of the Pap test in detecting precursors to or early adenocarcinoma. Future improvements to screening, such as the incorporation of HPV testing and further expansion and uptake of HPV vaccination programs, may help address the social inequalities observed in screening for squamous cell cancer and reduce adenocarcinoma incidence.

Cervical screening technology and burden of treatment of cervical intraepithelial neoplasia

Rebolj M[1], Lynge E[1], Kirschner B[2], Junge J[2], Rygaard C[2]

[1]University of Copenhagen, Copenhagen, Denmark; [2]Hvidovre University Hospital, Hvidovre, Denmark

Background: Denmark has a long-running organized cervical screening program, which reduced the burden of cervical cancer by treating cervical intraepithelial neoplasia (CIN). Because CIN can spontaneously regress, the reduction in cervical cancer incidence for some women has necessitated treatment of also non-progressive lesions. Danish screening program used to rely on conventional manually-read cytology, but more advanced cytological technologies and use of human papillomavirus testing have become increasingly common in the past decade. We

investigated how many women have been treated for CIN per prevented case of cervical cancer, and whether that number has depended on the screening method.

Methods: We retrieved CIN treatment data until end of 2010 from the National Pathology Data Bank, Health Service Register, and Patient Register. Cervical screening data were retrieved from the Pathology Data Bank, and cervical cancer data from the National Cancer Register. The number of CIN treatments per prevented cervical cancer case was estimated by comparing the change in the cumulative lifetime risks of cervical cancer from before to after the introduction of screening, with the lifetime risk of CIN treatment. Based on data from the largest Danish cervical screening laboratory belonging to Department of Pathology of Hvidovre University Hospital, we thereafter related the changes in the detection of CIN to changes in cytological technology. Since the late 1990's, this laboratory underwent five technological changes in screening methods.

Results: Until 2005, about six women were treated for CIN to save one case of cervical cancer. By 2007, this number increased to eight. Cytology screening data showed that the proportion of women with positive screening tests increased from 3.8 percent using conventional manually read cytology to 6.0 percent using liquid-based cytology with advanced automation-assisted reading and HPV triage for women aged 30 years or older with borderline abnormal smears. The increase in abnormal cytology was predominantly seen among young women. We are currently validating the assumption that the higher number of positive tests might explain the increase in the number of treated CIN per prevented cervical cancer case.

Conclusion: In recent decades, cytology screening has undergone several important technological changes. Although new technologies have been often rigorously evaluated for their impact on the effectiveness of screening, the evidence on their impact on the human cost of screening is scarce. Our data, currently undergoing thorough validation, suggest that in Denmark new technologies may have increased the burden of screening.

Evaluating New Technologies and Their Readiness for Incorporation into Organized Screening Programs (Other Cancer Sites)

Time-varying impact of HPV vaccination on cervical screening and diagnostic services in New Zealand

Canfell K[1], Lew J-B[1], Smith MA[1], Simonella L[1], Nickson C[2], Clements M[3], Walker RJ[2], Creighton P[2], Casey D[4], Lewis H[4]

[1]Cancer Council New South Wales, Woolloomooloo, New South Wales, Australia; [2]University of Melbourne, Melbourne, Victoria, Australia; [3]Australian National University, Canberra, Australian Capital Territory, Australia; [4]National Cervical Screening Programme, Wellington, New Zealand

Background: The National Cervical Screening Program in New Zealand (NZ) recommends 3-yearly screening in women ages 20 to 64 and currently performs approximately 400,000 liquid-based cytology screening tests per annum. Human papillomavirus (HPV) immunisation in NZ commenced in 2009, with routine vaccination in 12-year-olds and a catch-up to age 20. The aim of this evaluation was to predict the time-varying impact of vaccination on resource utilisation and outcomes in the organised screening program (assuming no change to current screening), considering the implications for screening and diagnostic services, cancer incidence, cancer mortality, and costs.

Methods: Analysis of data from sexual behaviour surveys was used to construct a model of HPV transmission and vaccination in NZ; because accurate data on vaccination coverage are not yet available we evaluated a range from 25 to 90 percent in 12-year-olds. The predicted HPV incidence rates were used to inform cervical intraepithelial neoplasia natural history models for vaccine-included and other oncogenic types, and cervical screening and management compliance in NZ was modeled using data from the national screening register over the period 1995–2005. A calibrated multiple cohort implementation was used to predict interim program outcomes for single-year birth cohorts, taking into account differences in HPV exposure; this was processed to provide cross-sectional outcomes. Future case numbers were calculated by incorporating information on predicted population age structures to 2050.

Results: In 2050, the overall number of cytology tests in the program will be almost unchanged, but the annual number of colposcopy referrals and treatments for CIN 2/3 will decrease by 9–29 percent and 12–40 percent, respectively. Cancer incidence will start to decline in around 2020 and the rate will be reduced by 24 percent in 2050 (feasible range 12–40 percent). By 2050 there will also be a small decline in cervical cancer mortality (less than 10 percent). Assuming no change to screening, the total annual cost of cervical cancer prevention (at current prices) will increase by 16–19 percent by 2050 due to the increased costs associated with vaccination.

Conclusions: In the context of HPV vaccination, the demand for diagnostic and treatment services in NZ will decrease by up to 30–40 percent, but this will occur over a 40-year period. An observable decline in cancer incidence is expected to commence approximately 10 years after starting vaccination, but this will not immediately result in a substantial reduction in cancer mortality. Total cervical cancer prevention costs will increase substantially unless future changes to cervical screening are made.

A randomised pilot program of implementation of HPV-based cervical cancer screening in routine activity

Ronco G[1], Segnan N[2], Gillio-Tos A[3], DeMarco L[4], Rizzolo R[5], Ghiringhello B[3], Allia E[2], Sapino A[2], Dalla Palma P[4], Prandi S[5], Campari C[5], Calvia M[5]

[1]Reference Center for Epidemiology and Prevention of Cancer (CPO) Piemonte, Torino, Italy; [2]University of Torino, Torino, Italy; [3]Sant'Anna Hospital, Torino, Italy; [4]Santa Croce Hospital, Trento, Italy; [5]Azienda Unità Sanitaria Locale di Reggio Emilia, Italy

Introduction: Randomised controlled trials showed that cervical screening based on testing for the DNA of high-risk human papillomavirus (HPV) allows, compared to cytology, earlier detection of persistent high-grade cervical intraepithelial neoplasia (hgCIN) and higher protection from invasive cancers. A randomised pilot project was started in 2009 to evaluate the practical feasibility, effect on participation, number of tests and colposcopies needed, detection of hgCIN, and financial costs of an HPV-based cervical screening implemented as a routine test.

Methods: Within three Italian organised screening programmes, women aged 35 to 64 years are randomly assigned, by birth cohort, to be invited either for cytology- or for HPV-based screening. Women in the HPV group are tested for HPV DNA only. A specimen for cytology is always taken but read only if HPV is positive. HPV-positive women with atypical squamous cells of undetermined significance or more severe cytology are referred to colposcopy. Those with normal cytology are invited for new HPV testing after 1 year. Women still HPV-positive at repeat are referred to colposcopy, while those who become negative will be re-invited to the new screening round. The costs of each single procedure (invitation, testing, colposcopy, etc.) were registered. The overall cost of screening was estimated applying them to the needed number, from such experience, and from literature data.

Results: One hundred twenty-nine thousand women were invited in either of the groups up to the end of 2011. Based on preliminary data, compliance to invitation was slightly higher among women invited for HPV testing (ratio versus cytology 1.02; 95 percent CI 1.00-1.04). Referral for test repeat was slightly higher in the HPV than in the cytology group (ratio 1.28; 95 percent CI 01.14-1.44). Referral to colposcopy, without taking into account those resulting from 1-year HPV repeats, was similar in the two arms (ratio HPV versus cytology 1.06; 95 percent CI 0.90-1.23). These data and the overall referral to colposcopy and detection of hgCIN are under up-grading. With the described protocol, the estimated cost of a single round per screened woman was higher with HPV than with cytology. However, when using 5-year intervals with HPV and 3-year intervals with cytology, the overall cost per woman screened between age 34 and 64 was about 20 percent lower with HPV than with cytology.

Conclusion: HPV-based screening is feasible in a routine setting. It does not reduce participation. Financial costs would be lower with HPV than with cytology extending the interval with HPV, as advisable, to 5 years.

Computer-aided detection in CT colonography (CTC): Which CAD paradigm is best in a screening population?

Segnan N[1], Regge D[2], Iussich G[2], Correale L[3], Senore C[1]

[1]University Hospital San Giovanni Battista in Torino, Reference Center for Epidemiology and Prevention of Cancer (CPO) Piemonte, Torino, Italy; [2]Institute for Cancer Research and Treatment, Candiolo, Torino, Italy; [3]im3D, Torino, Italy

Background: This study aimed to prospectively compare the diagnostic performance and time efficiency of primary and second reader computer-aided detection (CAD) paradigms.

Methods: Individuals participating in a colorectal cancer (CRC) screening program and with a positive fecal occult blood test (FOBT) test were recruited for same-day computed tomographic colonography (CTC) and conventional colonoscopy (CC). Two experienced radiologists independently analyzed the CTC studies following randomization, using CAD either as a first (CAD1) or as a second reader (CAD2); levels of confidence were assigned to positive findings. Reporting time, per-patient sensitivity for patients with adenomas or cancer of at least 6 milimeters in size, specificity, along with the relative 95 percent confidence intervals, and areas under ROC curves (AUC) were calculated for both reading paradigms. CC and histology were the reference standard.

Results: Seventeen of the 199 enrolled individuals (8.5 percent) were excluded for: refusal to perform CC (3), unavailable histological data (4), protocol violation (3), and non-diagnostic image quality (7). The remaining 182 individuals included 93 patients (51 percent) with at least one adenoma greater than or equal to □6 milimeters. Sensitivity with CAD2 and CAD1 was 86 percent (80/93) (77–92 percent) and 89 percent (83/93) (81–95 percent), respectively (P=0.5). There was no difference in specificity between CAD2 and CAD1 [89.9 percent (80/89) (81–95

percent) versus 91 percent (81/89) (83–96 percent)]. The mean AUCs for CAD2 and CAD1 were similar (P=0.09). CAD1 reading took 2 minutes less than CAD2 (6m:2s±55s versus 8m:7s±30s, P=0 .01).

Conclusion: CAD1 is more time efficient and has a similar diagnostic performance to CAD2 and should be considered for future mass screening programs, where cost-effectiveness may represent a key issue.

Adoption of iFOBT screening improved patient compliance, increased early-stage and decreased late-stage cancer in less than two years: The Kaiser Permanente Southern California experience

Schottinger J, Kanter M, Palmer-Toy D, Blau E, Goldberg R, Li Q, Rabot R, Collier M

Southern California Permanente Medical Group, Pasadena, California, United States

Background: Colorectal cancer (CRC) is the second leading cause of cancer death in the United States but highly treatable in early stages. Screening reduces both CRC incidence through removal of precancerous lesions and death through early detection. Improving screening rates among adults 50+ years of age is a national priority.

Kaiser Permanente Southern California (KPSC) provides comprehensive prepaid medical care to 3.6 million socioeconomically diverse members. The health plan is known for its commitment to prevention and evidence-based medicine. In 2006, per the *Healthcare Effectiveness Data and Information Set,* 53 percent of age-eligible KPSC members met criteria for screening by recommended tests: flexible sigmoidoscopy, colonoscopy, or guaiac fecal occult blood tests (gFOBT). Distributed by mail, the gFOBT has the advantage of being able to reach large numbers of patients. However, in contrast to the newer immunochemical iFOBT, the gFOBT needs samples from three stools and requires dietary/medicinal restrictions for up to 3 days before the test.

Methods: In 2007, we conducted a study among a random sample of 4,000 patients 50 to 80 years of age to assess their compliance with screening for CRC. Patients were randomized to be mailed either a gFOBT or iFOBT test kit with instructions and received an automated reminder call several days later to promote return of the kit.

Results: Significantly more patients returned an iFOBT kit compared with a gFOBT kit (26 percent versus 41 percent, respectively, p<.001). Importantly, compliance was higher across all demographic groups (age, sex, race/ethnicity). Results led to widespread adoption of iFOBT in the KPSC organization. This helped increase the health plan's overall CRC screening to 70 percent by 2009 and 73 percent by 2010. In addition, between 2005 and 2009, stage 0/1 CRC increased from 32 percent to 41 percent and stage 4 decreased from 17 percent to 12 percent.

A decrease in absolute numbers of stage 4 cancers was also detected, from 222 to 206.

Conclusion: Adoption of a more convenient CRC screening test led to higher participation in screening across all demographic groups. Consequently, iFOBT screening helped increase early-stage and decreased late-stage CRC in a large managed care organization.

Roles of Allied Health Professionals and Lay Health Workers in Screening

Use of allied health professionals to improve the efficiency and adherence to practice guidelines in colorectal cancer screening

Hilsden RJ[1,3], Rostom A[1,3], Dube C[1,2], McGregor SE[2], Pontifex D[3], Bridges RB[1,3]

[1]University of Calgary, Calgary, Albert, Canada; [2]Alberta Health Services – Cancer Care, Calgary, Albert, Canada; [3]Forzani & MacPhail Colon Cancer Screening Center, Alberta Health Services – Calgary Zone, Calgary, Albert, Canada

Background: Population-based colorectal cancer screening programs place a heavy demand on colonoscopy resources. Endoscopists could be better utilized by transferring some tasks to allied health professionals.

This study aimed to report the process and outcomes of using clerks and nurses to perform tasks traditionally performed by the endoscopist: referral triage; patient education, counseling, and medical assessment; and review of pathology results.

Methods: The Forzani & MacPhail Colon Cancer Screening Centre provides screening-related colonoscopies to residents of Calgary, Alberta, as part of Canada's publicly funded health care system and supports the Alberta Colorectal Cancer Screening Program. Triage and prioritization of referrals are performed by trained clerks and nurses. Prior to colonoscopy, patients undergo a preassessment visit at which time they attend a group education session led by a nurse and a one-on-one counseling and medical assessment completed by a nurse. After the colonoscopy, a nurse discusses the colonoscopy findings with the patient. Pathology reports are reviewed by one of three trained nurses, who determine the appropriate colonoscopy surveillance interval using an algorithm based on published clinical practice guidelines. On the day of the colonoscopy, endoscopists complete a limited assessment of the patient and perform the colonoscopy. Because of their restricted role, endoscopists bill the provincial health insurance plan a reduced fee. Protocols for the triage and medical assessment of patients and pathology review were developed by the Centre's medical leads. Assessment of the overall quality of care provided at the Centre is measured using the Global Rating Scale (GRS) for endoscopy, and specific care processes are assessed using annual surveys of patients and staff and semi-annual measurement of colonoscopy quality indicators.

Results: From 2008 to 2011, 33,000 colonoscopies were performed. In 2011, at least 95 percent of patients rated the group education session useful or very useful for learning about colon cancer screening and colonoscopy. Ninety-eight percent agreed or strongly agreed that they had enough information to prepare for colonoscopy, a good understanding of what colonoscopy would involve, and its potential risks. The Centre received "A" ratings (excellent service) on 8 of 12 GRS domains. Eighty-eight percent of staff indicated they felt valued for the contributions that they make. The reduced physician consult fee resulted in approximately a $2 million savings.

Conclusion: Use of allied health professionals facilitates the adoption of standardized evidence-based care protocols and can maximize the time endoscopists can spend performing colonoscopies while achieving a high level of patient and staff satisfaction.

The Mobile Women's Health Service (MWHS)

Peberdy L, Christie L

Queensland Cervical Screening Program, Brisbane, Australia

Background: The Mobile Women's Health Service (MWHS) provides an important outreach health service for women in rural and remote communities, including Aboriginal and Torres Strait Islander women and women from culturally and linguistically diverse backgrounds, who may be geographically or socially isolated.

The service is based in 15 locations across Queensland, and each is composed of a specially trained clinical nurse consultant who works as a sole practitioner to provide services that assist in the prevention, early detection, and management of women's health issues. In some locations an Aboriginal and Torres Strait Islander Women's health worker works with the nurse to assist in meeting the needs of local Aboriginal and Torres Strait Islander women.

Each MWHS travels within a radius of 500 kilometres, or to an agreed distance, from their base to provide health services for women either individually or in group settings. Services include education on a broad range of women's health issues, the provision of gynaecological clinical services such as cervical screening, and sexual health services.

The MWHS complements and works in conjunction with other health services, such as general practitioners and the Royal Flying Doctor Service, and has extensive referral networks to other health professionals in the area.

The Mobile Women's Health Service aims to promote, maintain and improve the health and well being of rural and remote women who may be geographically or socially disadvantaged. Objectives include to: increase the level of cervical screening among rural and remote women, particularly older women, Aboriginal and Torres Strait Islander women and women from culturally and linguistically diverse backgrounds, and women experiencing social or geographic disadvantage; provide outreach women's health services including health promotion programs, preventative and gynaecological clinical services (Pap smears, sexual and reproductive health), counselling, referral, and information; promote the Mobile Women's Health Service within a social context by recognising the preventative and health promotion needs of women throughout the various stages of their lives; increase service options for women, including access to a female practitioner; and provide information to both women and service providers.

Methods: Services and interventions can include: cervical screening (Pap smears); information about breast health and breast screening; information about menopause and symptom management; urinary conditions including continence; contraception, pre-conceptual health, and pregnancy counseling; sexuality concerns; sexual health and testing as relevant; puberty, menstrual, and reproductive health issues; early interventions and referrals for women's health issues including domestic violence and sexual assault; healthy lifestyle promotion including nutrition, weight, and stress management.

Radiology technologists as film readers in screening mammography by using the BIRADS system

Torres-Mejía G[1], Angeles-Llerenas A[1], Martínez-Montañez OG[1], Ortega-Olvera C[1], Carranza ML[3], Contreras D[2], González F[1], Lazcano-Ponce E[1], Montemayor-Varela E[1], Smith RA[2]

[1]Instituto Nacional de Salud Pública, Cuernavaca, Morelos, México; [2]Centro de Diagnóstico e Imagen México-España, Ciudad de México, México; [3]American Cancer Society, Atlanta, Georgia, United States

Backgound: In Mexico since 2006, breast cancer mortality has become the leading cause of death from malignant tumors, and after diabetes the second cause of mortality in women ages 30 to 54. Since 2011 mammography screening is recommended every 2 years in women ages 40 to 69 (n = 14, 312,729 according to the 2010 census). The Health Social Protection System, which attends to approximately 30.4 percent of the Mexican population, has 142 radiologists; among them 102 have been trained in mammography and only 60 work exclusively in screening, resulting in 36,000 readings per year per full time radiologist. Screening is not possible without either importing or training more radiologists or training non-radiologist readers. As a potential solution for the shortage of radiologists for the interpretation of mammograms in the screening programs, it has been proposed that non-radiologists read mammograms based on studies that have reported acceptable sensitivity and specificity following a period of intensive training.

This study aims to assess the sensitivity and specificity of a group of radiology technologists in the interpretation of mammography after a 6-month training program.

Methods: Radiology technologists from across Mexico were invited to participate; the inclusion criteria were to be working in breast screening and to obtain permission from their institution. A group of radiologists and epidemiologists developed the training program, which consisted of clinical lectures, training in service, and the reading of a progressive number of digital mammographic studies using the BIRADS system. Training starts with 10 readings and ends with 40 readings per day. All results are recorded daily, and the correlation between the technologists and radiologists' readings are evaluated. At the 4^{th} and 6^{th} months of training, a formal evaluation will be performed by using a previously validated test set of mammograms.

Results: Film reading performance is reported here by means of sensitivity and specificity. First findings will be ready by the end of September.

Evolution and determinants of mammography image quality in Switzerland

Bulliard, J-L[1], Richli Meystre N[2]

[1]Lausanne University Hospital, Lausanne, Switzerland; [2]University of Applied Sciences, Lausanne, Switzerland

Background: Although image quality in mammography has been positively associated with screening performance, mammography quality has seldom been assessed. In Switzerland, mammography screening programs undergo strict quality management procedures, which include continued training of radiographers. This study aimed to evaluate quality of mammograms in Switzerland and its evolution over time and identify its determinants.

Methods: Seven thousand three hundred fifty-two mammograms performed between 1999 and 2007 were randomly drawn from six hospitals in two cantons with and without a screening program and evaluated according to a slightly revised version of the PGMI (P: Perfect, G: Good, M: Moderate, I: Inadequate) classification system. Determinants of quality were assessed by multivariate logistic regression models.

Results: Overall, the inadequate image rate decreased over time (-0.80 percent/year, 95 percent CI: -1.14;-0.45) while the proportion of good or perfect images increased (+0.51 percent/year, 95 percent CI: 0.18-0.84). Higher image quality was associated with a mammogram being performed recently, for a cranio-caudal view, in a hospital with a high throughput (>250 mammographic images/radiographer/year) and within a screening program. The inadequate image rate was 28 percent lower (95 percent CI: 12-42) with a digital mammogram and a perfect or good image classification twice as likely in the region with an organized screening program (OR=1.96, 95 percent CI: 1.65-2.34).

Conclusion: Mammography image quality has steadily improved since 1999. Although quality-assurance procedures for screening programs have contributed to the higher quality, the difference across settings has decreased. The annual volume of images performed per radiographer appears to be a strong predictor of image quality.

Inter

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Poster Abstracts

Benefits, Harms and Costs of Cancer Screening Programs/Factors Influencing Policy and Decision Making

What is the "best buy" for screening of breast cancer?: Results from a systematic review of economic evaluations

Anothaisintawee T, Teerawattananon Y
Health Intervention and Technology Assessment Program, Bangkok, Thailand

Background: Breast cancer is the most common cancer found women in Thailand and all over the world. Although organized breast cancer screening with mammography was proved to be effective in reducing breast cancer mortality, many governments, especially in resource-limited settings, have not yet adopted the mammography for routine screening. One of the reasons is that they are doubtful about its value for money. Thus, this study aims to perform a systematic review of economic evaluation studies in order to determine the value for money of routine mammography screening compared with other preventive options or "do nothing."
Methods: We searched Medline until January 2012. Economic evaluation comparing cost and outcome of screening option(s) for breast cancer were selected. To facilitate cross-setting comparison, incremental cost effectiveness ratios (ICERs) were presented in 2012 international dollar unit using PPP index derived from the World Bank. Quality of studies was also assessed in order to provide recommendations for future improvement of economic evaluation of screening programs.
Results: We identified 26 studies of which a majority of them (22 studies) were conducted in the U.S. and European countries. Three studies and only one were conducted in Asia and Latin America, respectively. Twenty studies evaluated breast cancer screening strategies in general women, but six studies evaluated in high-risk population. Although almost studies identified mammographic screening as the "best buy," its ICERs varied widely, depending on local incidence of breast cancer, starting age, and frequency of screening, as well as additional technology provided with mammography such as MRI or genotyping. There is significant room for improvement of economic evaluation of breast cancer screening, especially for data used to estimate clinical effect size (effectiveness). Most of studies did not employ systematic reviews or derive the data from experimental studies.
Conclusion: It is important to encourage economic evaluation studies on breast cancer screening in resource-poor settings as the available or possible options are likely to be different from those of resource-rich settings. For example, screening only once in lifetime or screening only those with particular risk factors were rarely included in the studies conducted in United States and Europe. Also, rigorous methods to identify clinical effect size need to be used for future economic evaluation.

A comparison of harms and benefits of cervical screening from age 20 and from age 25 in the United Kingdom

Birke H, Castanon A, Sasieni P
Wolfson Institute of Preventive Medicine, Barts and The London School of Medicine and Dentistry, Queen Mary, University of London, London, United Kingdom

Background: In England a new policy was introduced in October 2003 regarding the age at which women are invited for cervical screening. Beforehand women were invited five-yearly from age 20 to age 64. The new policy

established that women receive the first invitation with their 25th birthday. Furthermore, women should be invited every three years up to 49 and every five years from 50 to 64. Wales has been screening women three-yearly from age 20 since 1999. Scotland also starts screening from age 20. The age at which to begin screening has always been controversial.
Methods: Here, we use routinely published statistics from England and Wales as well as unpublished data from the National Audit of Invasive Cervical Cancer to estimate of what would happen between ages 20 and 26 (inclusive) in terms of number of screens, women with abnormal test results, referrals to colposcopy, and women treated per 100,000 women invited for screening from age 20 compared to being invited from age 25.
Results: We found that screening from age 20 would lead to an extra 120,000 screens, 25,000 extra non-negative test results, 9,400 extra referrals to colposcopy, and 3,700 extra women being treated. We estimate that there would be 4 extra cancers diagnosed at stage 1A, but overall no change in the number of cancers.
Conclusion: In conclusion, starting screening 5 years earlier in 25,000 women, will down-stage one cancer but will result in an additional 900 women receiving treatment for cervical intraepithelial neoplasia.

Screening for mammography in older ages: 5-year prognostic indicator to facilitate clinical decisions

Breslau ES[1], Bellizzi KM[2], Schonberg MA[3]
[1]National Cancer Institute, Bethesda, Maryland, United States; [2]University of Connecticut, Storrs, Connecticut, United States; [3]Harvard Medical School, Boston, Massachusetts, United States

Background: Breast cancer is the second leading cause of death in the United States, and the risk for the development of cancer increases with age. The measure of life expectancy provides important information about health at a given population level in terms other than death, since at 75 years some older American women are physically and cognitively robust, while others are frail, have reduced functional ability, or have multiple comorbid illnesses. The purpose of this study was to describe mammography screening patterns in adults 75 years and older by 5-year life expectancy.
Methods: Our analytic sample consisted of 1,453 community-dwelling United States women aged 75 years and older who responded to the 2010 National Health Interview Survey. A validated index used 11 variables to categorize women into high, intermediate, and low 5-year life expectancy.
Results: The overall rate of breast cancer screening was 56.0 percent. When stratified by 5-year life expectancy, mammography screening rates were 68.0 percent in women with high life expectancy (≥48.0 percent probability of 5-year mortality), 51.2 percent in women with intermediate life expectancy (16.0 percent to 47.0 percent probability), and 38.8 percent in women with low life expectancy (≥15.0 percent probability). In multiple logistic regression analysis the variable related to increased mammography screening was women who were less than 80 years of age (Odds ratio [OR] 2.30; 95 percent Confidence Interval (CI): 1.33-3.95). Least likely to be screened were poor women with incomes less than $14,000 (OR 0.39; 95 percent CI: 0.21-0.72) and those with an intermediate life expectancy (OR 0.58; 95 percent CI: 0.37-0.93).
Conclusion: In an era of escalating healthcare utilization and expenditures in the United States, identifying areas for cost containment while concurrently improving quality of care in our healthcare system is increasingly paramount. These findings point to the large proportion of older adults (51.2 percent) with intermediate life expectancy who continue to be screened beyond recommended guideline ages, despite the likelihood of screening providing any survival benefit. The addition of a 5-year prognostic tool may be of clinical value when an informed cancer screening discussion between patients and providers is warranted, so as to talk about the benefits and harms of continued screening. Because of wide life expectancies among advanced ages, targeting screening to those who would benefit most would prevent over-testing and overtreatment, or undertreatment among the healthy.

First monitoring of Swiss breast cancer screening programs, 2010

Bulliard J-L[1], de Wolf C[2], B. Arzel B[3], C. Ducros C[4], Filliez B[5], Munoz C[6], Fracheboud J[7]

[1]Lausanne University Hospital, Lausanne, Switzerland; [2]Fribourg Breast Cancer Screening Centre, Fribourg, Switzerland; [3]Geneva Breast Cancer Screening Foundation, Geneva, Switzerland; [4]Vaud Breast Cancer Screening Foundation, Vaud, Switzerland; [5]Valais Breast Cancer Screening Centre, Valais, Switzerland; [6]Bern – Jura – Neuchâtel Breast Cancer Screening Centre, Bern, Jura, and Neuchâtel, Switzerland; [7]**Erasmus Medical Centre, Rotterdam, The Netherlands**

Introduction: Although organized breast cancer screening has been offered since 1999 in Switzerland, no harmonized monitoring of regional programs has yet taken place. Swiss programs differed in length of operation, multiple reading strategy, eligibility criteria, and covered populations with different screening habits and use of opportunistic screening. For the first time, a standardized monitoring report of all main indicators of performance was endeavored across all Swiss regional programs.

Methods: Data related to screening activities in the year 2010 were extracted from all five regional screening programs (Vaud, Geneva, Valais, Fribourg, and Bern – Jura – Neuchâtel). Consensual eligibility criteria and definitions of performance indicators were agreed upon by all programs, following as far as possible the European Guidelines and the Dutch experience in breast cancer screening reports.

Results: Indicators of participation, quality, and early effectiveness were computed for each program and screening round (prevalent versus incident). Overall, Swiss regional programs met most international standards of quality and effectiveness, in line with other service screening programs worldwide. Participation showed the widest variation due to large regional differences in screening context and habits. The impact of different definitions of indicators and eligibility criteria was also assessed but appeared to only partially explain the observed variation in performances.

Conclusion: In a decentralized healthcare context where screening interventions are implemented regionally, standardization procedures is necessary to improve the quality of reporting and the comparability of screening performance while minimally affecting regional specificities.

Evaluation of primary HPV screening with and without HPV vaccination in rural China

Canfell K[1,2], Shi J-F[1,2,3], Lew J-B[1], Walker R[1], Zhao F-H[3], Simonella L[1], Chen J-F[4], Smith M[1], Nickson C[1,5], Qiao Y-L[3]
[1]Cancer Epidemiology Research Unit, Cancer Council New South Wales, Woolloomooloo, New South Wales, Australia; [2]University of Sydney School of Public Health, Sydney, New South Wales, Australia; [3]Cancer Institute, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, People's Republic of China; [4]Dalian Medical University, Dalian, People's Republic of China; [5]University of Melbourne School of Population Health, Melbourne, Victoria, Australia

Background: The burden of cervical cancer in China has not been characterized in detail, and comprehensive evaluation of the cost-effectiveness of human *papillomavirus* (HPV) screening and vaccination in rural China has not previously been performed.

This study aimed to (1) review data sources and estimate the extent of the disease burden of cervical cancer in China; and (2) evaluate vaccination as an alternative or addition to primary HPV screening with careHPV (Qiagen, United States) and assess the threshold total cost per vaccinated girl (CVG) at which strategies involving vaccination would become viable compared to screening-only strategies in rural China.

Methods: (1) We reviewed cervical cancer data from national mortality surveys and registries. (2) We used data from field studies in Shanxi to support modelling of HPV vaccination and screening. We evaluated several strategies involving screening once or twice per lifetime or at regular 5-yearly intervals, with or without vaccination of young females aged 15 years, assuming 70 percent coverage for both screening and vaccination.

Results: (1) *International Agency for Research on Cancer* (IARC) registries record cervical cancer incidence in China as less than 5 per 100,000 (1998–2002), but the GDP per capita at each of the five registry sites is higher than China's average (by a factor ranging from 1.3 to 3.9). The predicted indicative annual number of new cervical cancer cases nationally (no intervention) ranges from approximately 27,000 to 130,000 (2010) to 42,000 to 187,000 (2050). (2) We found that strategies involving vaccination would be cost-effective at CVGs of US$50–54 or less, but at CVGs greater than $54, screening-only strategies would be more cost-effective. If vaccination of young cohorts is combined with two rounds of careHPV screening for women aged 30–59 years in 2012 and 2027, a

predicted indicative 33-percent reduction in cervical cancer incidence by 2030 would be sustained until 2050, with incidence rates decreasing thereafter.
Conclusion: (1) The evidence is consistent with considerable heterogeneity within China, and lower reported rates of cervical cancer should be interpreted cautiously. (2) Taking into account estimated vaccine delivery costs (for 3 doses), a per-dose HPV vaccine cost of approximately less than $9–14 would be required for strategies involving vaccination to be cost-effective. (3) Overall, combined screening and vaccination approaches are required to maximise outcomes in rural China.

Relative effectiveness measures: Defining and understanding the essential features for comparative effectiveness research

Chubak J[1], Rutter CM[1], Kamineni A[2], Johnson EA[3,4], Stout NK[5], Weiss NS[6], Doria-Rose P[7], Doubeni CA[7], Buist DSM[1]
[1]Group Health Research Institute, Seattle, Washington, United States; [2]University of Washington, Seattle, Washington, United States; [3]Harvard Medical School, Boston, Massachusetts, United States; [4]Harvard Pilgrim Health Care Institute, Boston, Massachusetts, United States; [5]Fred Hutchinson Cancer Research Center, Seattle, Washington, United States; [6]National Cancer Institute, Bethesda, Maryland, United States; [7]University of Massachusetts Medical School, Worcester, Massachusetts, United States

Background: Comparative effectiveness research must provide relevant information to help decision-makers shape policy and researchers compare results across studies. Our objective was to develop a framework for defining and differentiating the relative effectiveness of tests, regimens, and programs, using cancer screening as a motivating example.
Methods: We used real-world and hypothetical examples in cancer screening to develop a conceptual model relating different measure of effectiveness to one another. We used a hypothetical example of two screening regimens and two screening programs to compare measures of regimen and program effectiveness, defined by cancer mortality, to one another.
Results: We conceptually and algebraically defined measures of test, regimen, and program effectiveness. All assess intervention benefits in real-world setting, but each addresses a different scientific question. Together, they evaluate services ranging from one-time use of a test, treatment, or procedures through organized, population-wide prevention or treatment programs. Examples illustrate how effective screening regimens may not result in effective screening programs and how measures can differ across settings and subgroups.
Conclusion: A common lexicon will help facilitate communication and a shared understanding of comparative effectiveness measures among researchers, healthcare providers, and policymakers.

Individualized cancer screening guidelines can maximize clinical benefits and reduce costs

Dinh T[1], Alperin P[1], Smith R[2]
[1]Archimedes Inc., San Francisco, California, United States; [2]American Cancer Society, Atlanta, Georgia, United States

Background: It is not established that personalized cancer screening recommendations based on consideration of an individual's benefits and risks would be more cost-effective compared with the current population-based screening guidelines.
This study aimed to compare current guidelines with individualized guidelines in the context of colorectal cancer (CRC) screening stop age.
Methods: We used the Archimedes Model to compare the cost-effectiveness of a CRC screening strategy that recommends cessation of colonoscopy screening based on an individual's risk of cancer morbidity and mortality, life expectancy, likelihood of adverse events from screening, and past screening results against current recommendations of stopping CRC screening at age 75 in a population representative of the United States population. The cost-effectiveness results were reported for different subpopulations, stratified by risk of developing CRC and life expectancy.

Results: Our preliminary results demonstrated that individualizing the stop age of CRC screening improves health benefits and quality of life of patients and reduces costs, as compared to a fixed stop age strategy. Using a cost-effectiveness threshold of $50,000 per quality-adjusted life year, we showed that CRC screening in 75-year-old adults would be cost effective only if the patient's life expectancy exceeded 4.8 years. CRC screening for patients with a long life expectancy (over 10 years) and a high risk of developing CRC (e.g., due to family history) would lead to significant cost savings, exceeding $2,000 per patient. These cost-effectiveness results are sensitive to the distributions of dwell time of adenomas and sojourn time of tumors, colonoscopy performance, and costs of colonoscopy and CRC treatments. Individualized screening recommendations were also shown to reduce the number of adverse events due to screening.
Conclusion: Use of individualized guidelines can help to increase benefits of cancer screening and reduce the cost of care.

Optimizing mobile breast screening service delivery in Nova Scotia, Canada

Duggan RD[1], Foley TJ[1], Caines JS[1,2,3]
[1]Nova Scotia Breast Screening Program, Halifax, Nova Scotia, Canada; [2]Dalhousie University, Halifax, Nova Scotia, Canada; [3]*Queen Elizabeth II Health Sciences Centre,* Halifax, Nova Scotia, Canada

Background: Increasing funding does not always mean a better or more efficient service will be provided.
As of October 2008 all breast imaging in the province of Nova Scotia is done under the auspice of the Nova Scotia Breast Screening Program (NSBSP). Between 2007 and 2010 all 11 fixed screening sites were upgraded from Film Screen Mammography (FSM) to Full Field Digital Mammography (FFDM). One of the three provincial mobiles was also replaced with an FFDM mobile during this time period.
In 2010, facing financial limitations in the purchase of additional FFDM mobiles to replace the two FSM mobiles, the NSBSP was tasked to determine if mobile breast screening could be optimized to meet the needs of rural and priority populations while reducing costs.
Methods: Analysis took place using the 2009 mobile schedules, data from the NSBSP's database, and census data. Factors analyzed were the number of clients screened per mobile site, the scheduling efficiency; the proximity of mobile stops to fixed sites offering the same service; the proximity of the mobile stops to each other; and the geographical scheduling of consecutive mobile sites. Geographical mapping of data was used for information synthesis and dissemination.
Results: Based on the analysis above, the following statistics were determined: 1 in 3 screening mammograms were performed on a mobile; 15 percent of mobile appointments went unused; 62 percent of all mobile screens were performed within a 30 kilometer radius of a fixed site.
Conclusion: If mobile sites were scheduled in geo-sequential order, mobile units would travel 61 percent fewer kilometers. The three mobile units operated a total of 668 working days in 2009. Optimizing mobile scheduling to screen the same number of women in fewer days and removing mobile stops less than 30 kilometers from a fixed site would result in 283 workdays for all mobile screening in the province. This would allow for a single mobile to service the entire province instead of three. Provincial breast screening was once coordinated through one fixed site and three mobiles. Now with 11 fixed sites dispersed across the province there are still 3 mobile units that service over 60 mobile stops. Mobile stops in close proximity to fixed sites should be removed in order to cease service redundancies and reduce costs. A single mobile unit can provide service for rural areas and populations that cannot easily access fixed sites. Fixed sites will absorb the mobile screens that occurred in their catchment area.

False-positive results in a colorectal screening program: Participant-related factors and cumulative risk over a 10-year period

Garcia M[1], Milà N[1], Binefa G[1], Espinàs JA[2], Borràs JM[2], Moreno V[1]
[1]Catalan Institute of Oncology, L'Hospitalet de Llobregat, Spain; [2]Catalan Health Government, Barcelona, Spain

Background: Randomized controlled trials support the efficacy of fecal occult blood testing (FOBT) in decreasing colorectal cancer (CRC) mortality. However, evidence of a favorable balance of benefit to harm in a research setting does not guarantee that a similar balance will be reproduced in practice. The most common potential adverse consequence is a false-positive result, which often brings with it physical, psychological, and economic burdens of further diagnostic testing.
This study aimed to identify factors associated with a false-positive result in the CRC screening program with fecal occult blood test in Catalonia, Spain, and estimate the cumulative risk of having a false-positive result through four screening rounds.
Methods: The study population consisted of participants of the Catalan CRC screening program with a positive FOBT who underwent a colonoscopy for diagnostic confirmation from 2000 to 2010. A false-positive result was defined as having a positive test but no high-risk adenoma or cancer detected in the follow-up colonoscopy. The information system to manage the CRC screening program included data on patient identification, age, sex, participation, appointment dates, screening test (guaiac test or immunological test), and colonoscopy results. Regarding participation we differenciated initial screening (first participation) from subsequent screening (prior participation). We also revised colonoscopy reports to identify sources of rectal bleeding such as hemorrhoids and anal fissures and severe complications during the diagnostic procedure. Multivariate logistic regression models were performed to identify sociodemographic and screening variables associated with a false-positive result. Adjusted odds ratios (OR) and their 95 percent confidence intervals (95 percent CI) were estimated.
Results: Over the screening period, 1,074 (1.7 percent) of the 63,332 screening tests had a positive result in the Catalan CRC screening program. The false-positive proportion was 55.2 percent (n=546). Women were more likely to have a positive FOBT in the absence of CRC neoplasia than men (adjusted OR=2.91; 95 percent CI:2.22-3.28). During the first prevalence round, the proportion of false-positive results was higher than in subsequent rounds (69.5 percent versus 48.9 percent; $p<0.05$). Rescreening and having a bleeding pathology such as hemorrhoids or anal fissures were also associated with a false-positive result. The cumulative risk of a false-positive result after four rounds was estimated at 7.47 percent.
Conclusion: Gender-differences in false-positive results were the most remarkable findings and merit more research. On the other hand, the proportion of false-positive results and their associated risks should be estimated to provide eligible population with more reliable information on the adverse effects of screening.

Outcomes of an organized population-based colorectal cancer screening program with Hemoccult SENSA

Kershenbaum A, Flugelman A, Lejbkowicz F, Arad, Rennert G
Clalit Health Services National Israeli Cancer Control Center, Carmel Medical Center, B. Rappaport Faculty of Medicine, Haifa, Israel

Background : Fecal occult blood (FOB) testing for early detection of colorectal cancer is an evidence-based screening strategy and is the most commonly chosen approach in organized population-based colorectal cancer (CRC) screening programs throughout the world. Several FOB tests are available that differ in their test qualities. We studied the real-life experience of a large population-based, organized, screening program in Israel that employs FOB testing with a sensitive guaiac test (Hemoccult SENSA).
Methods: All eligible members of Clalit Health Services are actively invited to perform a free-of-charge, home-based, fecal occult blood test, using Hemoccult SENSA, a guaiac test with increased sensitivity. All tests with positive results are followed up, and information on colonoscopy, surgical procedures and pathology findings is collected. Performance characteristics including test positivity rate, cancer and adenoma detection rates, cancer stage at diagnosis, and test's positive predictive value (PPV) were evaluated.
Findings: During an 18-month period (July 2007–December 2008), 382,792 FOBT tests (in 325,851 people) were performed by the target population. Seven hundred eighteen colorectal cancers and 2,652 adenomas were detected. The overall test positivity rate in repeatedly tested people was 4.2 percent; higher in males and Arabs than in females and Jews. The overall detection rate for colorectal cancer was 2.2 per 1,000 persons screened. The overall detection rate of colorectal cancer in the subsequent tests was 1.7 per 1,000 reflecting 91 percent of the expected period-incidence of CRC. Forty-two percent of the cancers were detected at stages Duke's B1 and lower

and another 28 percent at Duke's stage B2. Left-sided cancers were detected at a significantly better stage than right-sided cancers ($p<0.001$).
Interpretation: The Clalit-organized colorectal cancer screening program, using Hemoccult SENSA, has reached the targets of high detection rate of cancers at low stage while keeping a low positivity rate. This approach demonstrates an efficient field-tested alternative to other, more costly, screening options.

A summary of the effective dose assessment for participants in the National Lung Screening Trial (NLST) receiving posterior-anterior (PA) chest X-ray and low-dose computed tomography (CT) examinations

Kruger RL[1], Flynn MJ[2], Judy PF[3]
[1]Marshfield Clinic, Marshfield, Wisconsin, United States; [2]Henry Ford Health System, Detroit, Michigan, United States; [3]Brigham & Women's Hospital, Boston, Massachusetts, United States

Background: The USA National Lung Screening Trial (NLST) is a multi-center randomized, controlled trial comparing low-dose helical computerized tomography (LDCT) to chest x-ray (CXR) in screening older current and former heavy smokers for early detection of lung cancer. Recruitment was launched in September 2002 and ended in April 2004 when 53,454 participants had been randomized at 33 screening sites to either LDCT or CXR in equal proportions. The objective of this study is to provide a concise summary of the effective dose for individual NLST participant LDCT and CXR examinations and discuss how this information relates to community-wide screening programs.
Methods: A total of 73,733 chest x-ray exams were performed on 92 chest-imaging systems, of which 66,157 examinations were included in the CXR assessment. The effective dose per entrance skin air kerma for each exam was determined using a Monte Carlo-based program. The Computed Tomography Dose Index (CTDIvol) data was annually assessed for the 97 multi-detector scanners used to image 26,724 participants during the trial. The dose data were representative of the imaging protocols used by the sites for their average size participants. Effective doses were first estimated by using the product of Dose Length Product (DLP) (CTDIvol x 35 cm scan length) and a published conversion ("k") factor. The commercial software product CT-Expo was then used to estimate male and female organ doses from the average CTDIvol. Applying both International Commission of Radiological Protection (ICRP) 60 tissue weighting factors and the more recent ICRP 103 weighting factors allowed comparisons of male and female effective dose.
Results: This study found that the mean effective dose assessed from 66,157 posterior-anterior chest examinations was 0.052 mSv, a median effective dose of 0.038 mSv, a 95th percentile value of 0.136 mSv, and a 5th percentile value of 0.013 mSv. The product of DLP and k factor resulted in a mean effective dose of 1.4 mSv (SD = 0.5 mSv) for a low-dose scan across all scanners. Results from CT-Expo, using ICRP 60 weighting factors, yielded effective doses of 1.6 mSv and 2.1 mSv for male and female respectively; whereas, ICRP 103 weighting factors resulted in effective doses of 1.6 mSv and 2.4 mSv respectively.
Conclusion: This study reports the effective dose for individual NLST chest x-ray examinations and is of specific interest in relation to that associated with the NLST low-dose CT examinations conducted during the trial.

Assessing new evidence on lung cancer screening, planning and policy implications, and potential impact of different strategies in Canada

Liu FF, Miller A, Bryant H, Fairclough L
Canadian Partnership Against Cancer, Toronto, Ontario, Canada

Background: The recent publication of mortality results from the National Lung Screening Study and the lung screening component of the Prostate, Lung, Colorectal, and Ovarian trial have generated interest in lung cancer screening and its feasibility in Canada and elsewhere. Low-dose computed tomography (CT) lung screening is not a usual practice in Canada for high-risk smokers/ex-smokers, and its introduction into practice would have many implications for the target population and the health care system. The Canadian Partnership Against Cancer

(CPAC), established in 2006 by the Canadian federal government, is implementing a national strategy to improve cancer control strategies in Canada by working together with the 13 provinces and territories and other key stakeholders. This includes dealing with potentially beneficial new screening strategies. This assessment aimed to support a national approach to develop a shared understanding of key new lung cancer screening evidence, including potential benefits, harms, and costs of screening the eligible high-risk population.
Methods: For the Anticipatory Science Initiative, an expert panel developed a brief, but comprehensive synopsis of the lung cancer screening trials, their results, and planning implications for distribution to key screening policy/planning stakeholders in a timely fashion. Cancer Risk Management Modelling of scenarios of lung cancer screening in Canada were conducted, including the impact of smoking cessation added to screening. Estimated health benefits, harmful events and costs have been modelled. A shared understanding across the country of the output from the Anticipatory Science Initiative and Cancer Risk Management Modelling and dialogue on planning and policy issues were facilitated by CPAC, which held two lung cancer screening forums with invited participants from all provinces/territories to discuss and debate the information.
Results : A summary document with key details of the screening trials and their mortality results was produced by the lung expert panel. This was presented at the initial forum, along with presentations on benefits and harms of screening. Participants deliberated about gaps in knowledge, clinical pathways, and potential health services and screening program needs. A list of additional information needed was produced. The same group met at a second forum 3 months later, where there were presentations on the information needed, including computed axial tomography numbers in the country, provincial utilization, and the results of the cancer risk management modeling of different scenarios. Results of the refined modelling of scenarios in the Canadian context will be presented as well as the concensus for action and next steps in Canada.

Screening in older age: Awareness of current options and patient preferences among older people in England

Macedo A[1], Waller J[1], Simon A[1], Jones C[1], Hammersley V[2], Weller D[2], Campbell C[2], Wardle J[1], von Wagner C[1]
[1]Cancer Research United Kingdom Health Behaviour Research Centre, University College London, London, United Kingdom; [2]The University of Edinburgh, Edinburgh, United Kingdom

Background: International guidelines vary in their recommendations for age of cancer screening stoppage. In England, routine screening stops are variable: currently these are 65 years for cervical and 70 years for breast and bowel cancer screening, while women over 65 are still eligible for cervical screening if they have not been screened since the age of 50 or have had recent abnormal tests. Relatively little is known about what the public thinks about opt-in rules for cancer screening programmes. This study aimed (1) to explore attitudes and preferences about recommendations in the breast, cervical, and bowel National Health Service (NHS) cancer screening programmes among men and women who were over or close to reaching the upper age limit for screening and (2) to examine whether these varied by socioeconomic status.
Methods: The study used a population-based survey of English adults in 2011, with a sample of men and women aged from 60 to 80 years living in England (n=1,147). Participants were recruited as part of a TNS Research International survey and took part in home-based computer-assisted interviews. Outcome measures were (1) levels of awareness and attitudes to options currently available in cancer screening; (2) personal preferences for how a recommendation after the end of a screening programme should be communicated; and (3) intentions to participate in future opt-in rules. Descriptive statistics and chi-square tests were used to analyse data and explore socio-demographic variables according to social grade and across 5-year age bands (60–64; 65–69; 70–74; ≥ 75 years).
Results: Fifty-six percent of participants were women. Women were more likely to be aware of opt-in rules than men: levels of awareness among women differed significantly by age group. The majority of respondents (76 percent) considered that they should not have to ask for screening once they are outside the age range, irrespective of gender or age group. Seventy-eight percent of respondents reported wanting a strong recommendation to carry on asking for screening after the age of eligibility, particularly in younger age groups. Most respondents (59 percent) wanted a letter from their general practitioner explaining that they could continue

to have screening; this preference was particularly marked among lower social grade groups. Intention to ask for a referral for screening was stronger among higher social grades but did not vary across age groups.
Conclusion: This study indicates a strong preference among older people in England to continue to be invited for cancer screening, with a preference for primary care involvement in the invitation process.

Colorectal cancers prevented in Czech national screening programme: Use of Markov model for synthesis of clinical and administrative data

Majek O[1], Suchanek S[2], Zavoral M[2], Kozeny P[3], Dusek L[1]
[1]Masaryk University Institute of Biostatistics and Analyses, Brno, Czech Republic; [2]Charles University, Central Military Hospital, Prague, Czech Republic; [3]Czech National Reference Centre, Prague, Czech Republic

Background: Czech National Colorectal Cancer Screening Programme was initiated in the year 2000 with biennial faecal occult blood test (FOBT) for individuals over age 50. Since 2009, patients can opt for annual (individuals aged 50–54 years) or biennial (individuals over 55) FOBT or primary screening colonoscopy every 10 years. Our objective was to estimate the number of colorectal cancers (CRCs) prevented by FOBT screening through removal of advanced adenomas.
Methods: Since 2006, results of FOBT-positive follow-up colonoscopy examinations in collaborating programme centres have been recorded in an electronic registry. This registry allows us to estimate the proportion of advanced adenomas detected in followed-up subjects. Administrative data of all Czech healthcare payers were made available through the Czech National Reference Centre and provided information about population coverage by FOBT and its positivity. As the electronic registry does not provide complete coverage of follow-up colonoscopy examinations, a decision tree was constructed to estimate annual numbers of patients with removed advanced adenoma utilising previously estimated compliance of FOBT-positive subjects with follow-up colonoscopy. Potential progression of removed advanced adenomas to preclinical and clinically manifest CRCs was modelled using two consecutive Markov models, using previously published rates of progression. Czech National Cancer Registry was used for estimation and projection of CRC rates for reference.
Results: The annual number of patients undergoing screening FOBT gradually increased from 12,000 in 2000 to over 400,000 in 2009; however, the estimated biennial coverage of the Czech target population by FOBT remains pretty low (20.2 percent in 2009). Over years 2000–2009, the estimated number of FOBT-positive patients with detected and removed advanced adenomas was 11,334. Clinically manifest CRC was prevented in 417 patients before 2009. Assuming participation and adenoma detection rates estimated in 2009 will continue in the following years, 388 CRCs will be prevented in 2015, yielding a cumulative number of 2,011 prevented cases during the years 2000–2015. Expected reduction of CRC incidence in 2015 is 4.1 percent in comparison with projected colorectal cancer rates.
Conclusion: Although the primary objective of FOBT screening is CRC early detection, prevention of CRCs through detection and removal of advanced adenomas may also provide substantial public health benefit in the long term. Efforts to increase participation of individuals from the Czech target population are nevertheless needed to achieve greater effectiveness as regards both prevention and early detection of CRCs.

Estimation of overdiagnosis rates for invasive and in situ breast cancer

Massat N, Moss S, Sasieni PD, Duffy SW
Queen Mary University of London, London, United Kingdom

Background : A central policy-related research question to be addressed is the potential detrimental effect of overdiagnosis of National Breast Screening Programmes. We are currently implementing a case-control evaluation of the National Health Service Breast Screening Programme in England and will be investigating this issue/attempting to estimate the rate of overdiagnosis due to screening in women diagnosed since 2008.
Methods: Meeting the above aim will entail using live as well as dead cases which will be compared to living controls who have not had breast cancer prior to the date of diagnosis of the matched case. The case-control comparison will be with respect to screening history prior to the date of diagnosis of the case, in particular with

respect to “time since last screen”, since one might expect an immediate increase in incidence with a screen (the screen-detected cases), followed by a deficit in incidence due to the removal of pre-symptomatic cases by the screen. This deficit would be expected to be attenuated with time since the screen. In addition, this case-control comparison with respect to “time since last screen attended prior to diagnosis/pseudo-diagnosis” will be stratified by age at diagnosis/pseudo-diagnosis to determine the effect of being screened on the incidence of disease at different ages, and thus to estimate rates of overdiagnosis due to screening in those age ranges (Sasieni et al., 2009). Indeed, one might expect an excess risk of disease to be observed with screening within the age range for screening (50–69) and a deficit in risk above the age range. A potential deficit in incidence may also be seen at later ages within the screening age range: at ages 65–69, there has potentially been 15 years of screening. Whether these risks are observed as expected and the exact quantification of these will enable us to estimate overdiagnosis. The estimation will be performed for both invasive and in situ (DCIS) disease.
Results: Preliminary data illustrating some of the principles will be presented. Comparisons will be adjusted for self-selection bias (Duffy et al., 2002).
Conclusion: Other potential biases and methodological issues will be discussed.

Population-based parameters for breast clinics

Migowski, A, Tomazelli JG, Assis M, Ribeiro CM, Silva RC
Instituto Nacional de Câncer, Rio de Janeiro, Brazil

Background : Even in settings where screening coverage is high, a large proportion of breast cancer cases still presents as a palpable lesion. Due to situation there are currently no parameters for the establishment of reference services for the diagnosis of breast cancer. This study aimed to estimate population-based parameters for the need of diagnostic tests for breast cancer, considering simultaneously symptomatic patients and those from the screening, and indicators to evaluation of the offer.
Methods: The first step was to estimate the number of new cases of breast cancer. Assuming that tumors "T0N0M +" or "TXNXM +" are very unusual, we admitted that almost all cases of suspected breast cancer were referred for breast clinics. The second step was to calculate the proportion of cases treated in a breast clinic that originally corresponded to palpable lesions. We used two alternative approaches in this step: data from studies or a conversion of TNM classification available in the cancer registries. The third step was to calculate the total demand expected in the breast clinic, including suspected cases that have no confirmation of cancer. In this step we assume that the detection rate of cancer in subsequent screening examinations is about 0.4 percent, that 8.3 percent of screened women will have abnormal tests, and that 10 percent of cases with palpable suspicious lesions referred by primary care have confirmed cancer diagnosis. The last step is to calculate the demand for diagnostic procedures, considering the differences in the cases coming from palpable lesions and those coming from mammographic screening. Finally, the model was applied to one Brazilian state (Pernambuco).
Results: In accordance with the calculated parameters, the ratio between actual production and the estimated need was 7 percent, 18 percent, 54 percent, and 71 percent respectively for fine needle aspiration, core biopsy, excision biopsy, and diagnostic mammography.
Conclusion: The estimated parameters show that there are difficulties in accessing confirmation diagnostic confirmation, compromising the effectiveness of early detection programs and contradicting the common sense that only focuses on offering screening mammography. The model also makes it possible to estimate costs of the diagnostic procedures and need for human resources.

Mammographic screening is associated with a reduction in breast cancer mortality: Robust evidence from an Australian case-control study and meta-analysis

Nickson C, Mason K, English D, Kavanagh A
University of Melbourne School of Population Health, Carlton, Victoria, Australia

Background: Observational studies are necessary to directly evaluate the real-world impact of population screening programs on breast cancer mortality. Some ecological studies have notably found little or no association,

yet case-control studies have consistently demonstrated a strong association. We conducted a case-control study of breast cancer deaths in Western Australia to evaluate the effect of participation in the long-running BreastScreen Australia program and examined potential sources of bias in a series of sensitivity analyses.
Methods: Cases comprised 427 women who died from breast cancer between 1995 and 2006, with each case matched by year and month of birth to up to 10 controls. For our primary analysis we used conditional logistic regression to estimate the association between screening participation and breast cancer mortality for women in the BreastScreen target age range (50–69), using an approach that we considered least sensitive to theoretical biases given the information available.
As a sensitivity analysis we quantified the impact of theoretical sources of bias not addressed in our primary analysis or addressed differently by other authors by executing a series of alternative analytic models in which we varied our treatment of potential sources of selection bias, information bias, and confounding. We also conducted a meta-analysis of published results from case-control studies.
Results: The odds ratio (OR) for participation in the Western Australian BreastScreen program among women dying from breast cancer was 0.48 (95 percent CI 0.38-0.59, p<0.001). Sensitivity analyses generated ORs ranging from 0.45 to 0.52. Meta-analysis of results from 11 case-control studies including our own yielded an overall OR of 0.50 (95 percent CI 0.46-0.55), with individual study ORs ranging from 0.30 to 0.65 but no significant heterogeneity between studies.
Conclusion: Our findings are consistent with those of other case-control studies, suggesting an approximate 50 percent reduction in breast cancer mortality among women who were screened in the Australian target age range of 50–69 years. Importantly, we were unable to find any biases that could negate this finding, suggesting that despite much discussion of theoretical bias case-control studies offer a robust and consistent contribution to evidence that screening is of benefit to women who choose to be screened. Future debate about the mortality benefit of breast cancer screening should give greater weight to existing evidence from case-control studies.

Population impact of the National Bowel Cancer Screening Program in Western Australia

O'Connor K[1], Ee H[1,2]
[1]Western Australia Department of Health, Perth, Western Australia, Australia; [2]Sir Charles Gairdner Hospital, Perth, Western Australia, Australia

Background: This oral presentation will discuss elements related to the population impact of the National Bowel Cancer Screening Program (NBCSP) in Western Australia (WA). The NBCSP commenced in WA in January 2007. Members of the population aged 50, 55, or 65 years, as identified by Medicare Australia and the Department of Veterans Affairs, are sent a free Faecal Occult Blood Test (FOBT) kit in the mail and invited to screen. A project to collect histopathology data was used to assess the NBCSP's impact on colorectal cancer (CRC) rates among the eligible WA population to September 2010.
Methods: Participants with positive FOBT results (n=5,343) were identified by the NBCSP Register to state-based Follow-Up Officers and cross-matched to four WA laboratory's databases (representing 91 percent of colorectal pathology reporting in WA) to ascertain histology findings. The WA Cancer Registry (WACR) was searched to identify all CRC diagnosed in WA among 50-, 55-, and 65-year-olds. The WA CRC detection rate was derived by dividing the number of CRC cases in each age group by its corresponding population for the study period. The CRC rates for corresponding pre- and post-NBCSP intervals for each age group were compared with age-matched WACR data using 95 percent confidence interval method to determine population impact.
Results: The project identified 2,808 histopathology reports representing 2,543 individuals. Significantly more males than females were identified on the Register list (M=63 percent; F=37 percent; p=<0.001) and had a pathological finding of adenoma or cancer (M=66 percent; F=34 percent; p=<0.001). In total, 160 NBCSP participants had a CRC identified (6.3 percent; M=64 percent; F=36 percent; p=<0.001). Almost 50 percent (225/457) of CRCs identified in the eligible age groups on the WACR were due to the NBCSP. Of the NBCSP cancers with staging information, 37 percent (34/ 91) were stage I disease. The rate of CRC detection in WA has significantly increased from 89.1/100,000 pre-NBCSP to 180.3/100,000 post-NBCSP in a time-matched comparison.
Conclusions: NBCSP's implementation in WA has resulted in a substantial increase in population CRC detection for the eligible age groups. Stage I detection correlates to national trends in earlier stage disease detection among

participants.[1] Increasing participation (WA crude participation = 43 percent[1]) and expanding the eligible cohort will maximise population benefit and should be a priority for policy makers, based on this evidence. The oral presentation will expand on pre- and post-NBCSP comparison rates and analyse impact in specific areas of WA to guide future health service provision.

The Breast Cancer Surveillance Consortium (BCSC) Research Resource: A source for data and opportunities for collaboration

O'Meara ES[1], Marcus PM[2], Ichikawa L[1], Buist DSM[1], Geller BM[3], Henderson L[4], Hill DA[5], Kerlikowske K[6], Onega T[7], Sprague BL[7], Rozjabek H[2], Miglioretti DL[1]
[1]Group Health Research Institute, Seattle, Washington, United States; [2]National Cancer Institute, Bethesda, Maryland, United States; [3]University of Vermont, Burlington, Vermont, United States; [4]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States; [5]University of New Mexico School of Medicine, Albuquerque, New Mexico, United States; [6]University of California, San Francisco, San Francisco, California, United States; [7]Dartmouth Medical School, Lebanon, New Hampshire, United States

The Breast Cancer Surveillance Consortium (BCSC) created the most comprehensive longitudinal collection of data on breast cancer screening and outcomes in community practice in the United States. We are pleased to announce the establishment of the BCSC Research Resource. We encourage investigators, including junior investigators and pre-doctoral students, to explore opportunities to work with the BCSC data and collaborate with Consortium members. Our goal is to facilitate research that improves breast cancer screening and reduces cancer burden and mortality.

The BCSC Research Resource supports innovative population-based screening research using data collected from 1994 to 2009 by a collaborative network of seven United States breast imaging registries. Data are available on more than 2.3 million women and include 9.5 million breast imaging examinations (primarily mammography). Data on patient demographics, risk factors, clinical history, breast density, indication for exam, radiologist's assessment and recommendation, pathology, cancer characteristics, and vital status are available. The BCSC Research Resource includes more than 95,000 breast and 4,500 ovarian cancer cases. Data on 180,000 benign and malignant breast biopsies and 150,000 deaths are also available.

The BCSC Research Resource can be used to answer key questions about breast cancer risk, detection, and outcomes in community settings. BCSC data have been used to investigate mammographic performance, shed light on risk factors, improve risk prediction, evaluate disparities, investigate the relationship between cancer biology and detection, examine survivorship, and develop microsimulation models and statistical methods. BCSC data have been used in more than 400 publications and 70 research grants, many led by investigators not previously affiliated with the Consortium. Collaborators include primary care clinicians, radiologists, pathologists, epidemiologists, health services researchers, and biostatisticians.

Researchers can request custom datasets to evaluate project feasibility, develop grant proposals, and conduct research studies. Independent projects as well as collaborations with BCSC investigators can be proposed. Statistical analysis support is available. Two downloadable, de-identified data sets—one on risk estimation and the other on risk of breast cancer with hormone therapy—are available at the BCSC website (breastscreening.cancer.gov), and other data sets are forthcoming.

Thanks to funding from the National Cancer Institute, **BCSC data and most associated services are currently available at no charge for approved proposals.**

Our poster will provide more detail about the BCSC Research Resource and will describe how interested investigators can request data, propose ideas, and establish collaborations. Visit the BCSC website (http://breastscreening.cancer.gov/) or contact the Statistical Coordinating Center at scc@ghc.org for more information.

Inefficiencies and adverse outcomes in unmanaged cervix cytology and diagnostic colposcopy

Paszat L[1], Lu Y[1], McGhee J[2], Kupets R[3], Rabeneck L[3]

[1]Institute for Clinical Evaluative Sciences and University of Toronto, Toronto, Ontario, Canada; [2]University of Western Ontario, London, Ontario, Canada; [3]University of Toronto, Toronto, Ontario, Canada

Background: In Ontario, 4.5 million women are eligible for screening cytology and diagnostic colposcopy. Guidelines for cytology and colposcopy are not enforced by the payor. Access to cytology is opportunistic/initiated by the woman and physician. Community laboratories submit cytology results to the physician and to a database. Referral to colposcopy for abnormal cytology is initiated by the physician who obtained the sample. Histology reports are sent to the colposcopist but not collected. In 2010, the rate of cytology peaked among women aged 25–29 at 38,551 per 10^5 and fell to 34,775 per 10^5, 32,095 per 10^5, and 25,302 per 10^5 at ages 40–49, 50–59, and 60–69. Colposcopy episodes initiated in 2010 peaked among women aged 20–24, dropped by 35 percent among those aged 30-39, and dropped by another 20 percent among those aged 40–49. 39.47 percent of all colposcopy episodes preceded by high grade squamous intraepithelial lesion (HSIL), 51.00 percent preceded by low grade squamous intraepithelial lesion (LSIL), and 39.92 percent preceded by atypical squamous cells of undetermined significance (ASCUS) occurred among women under 30. Mean colposcopy procedures per episode was 2.47 (SD 1.83) among those aged 20–24 and decreased with age. At all ages, mean procedures per episode (not including any treatment of the cervix) was only slightly lower than the overall mean. Mean duration of colposcopy episodes in days was 260.17 (SD 309.56) and decreased with age.
Methods: A retrospective cohort of Ontario females aged 14–18 on January 1, 1992, was followed to December 31, 2010, for first colposcopy, cervix treatment, and delivery. Females with prior colposcopy and treatment had increased obstetric complications before and around the first delivery compared to females with colposcopy but no treatment. The OR for having cervix treatment prior to cervical cerclage for incompetence is 2.12 (1.66, 2.72) (254 excess cases among 12,533 exposed); regarding premature rupture of membranes, OR 1.27 (1.14, 1.41)(598 excess cases), and prematurity/low birth weight OR 1.36 (1.22, 1.50) (338 excess cases).
Results: We show major utilization among the young (low risk of persistent high-risk human papillomavirus/cancer, who suffer obstetrical complications). We show decreased utilization among the older (who have higher risks of persistent infection/invasive cancer). We show over 25 percent of older Ontario women with HSIL had no colposcopy/intervention up to 2 years later (Kupets 2011), and the majority of Ontario women who develop invasive cancer are over 40 and without cytology/colposcopy/treatment many years prior (Spayne 2008).
Conclusion: Efficiency and effectiveness would be improved by targeted invitation to screen and managed colposcopy referral.

Costs and potentially morbid treatments associated with periodic mammography in Ontario

Paszat L[1,2], Baxter N[1], Holloway C[2,3], Rakovitch E[2,4], Chiarelli A[1,2]
[1]Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada; [3]St. Michaels Hospital, Toronto, Ontario, Canada; [4]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [5]Cancer Care Ontario, Toronto, Ontario, Canada

Background: In order to estimate costs and potentially morbid interventions associated with periodic mammography (PM), we merged individual health information from the Ontario Health Insurance Plan, Hospital Discharge Abstract Database, Ontario Breast Screening Program, Ontario Cancer Registry and the Ontario Case Costing Initiative.
Methods: We have defined PM as bilateral mammography performed within the age-specific interval in which one bilateral mammogram would be followed by a second (if age 42–49, 11 to 18 months; if age 50–74, 11 to 36 months), if deliberate periodic screening is intended (excludes prevalence or initial screening). We have defined subsequent events possibly prompted by the PM as the following as they occur 1 day to 6 months following the PM: additional mammography, breast ultrasound, breast magnetic resonance imaging, breast biopsy, detected cancer, in situ or invasive, and missed/interval cancers. We categorized mutually exclusive groups among all invasive or in situ cancers diagnosed among the underlying eligible population between the ages of 42–74 from 2001 to 2010, by periodic mammography status: less than or equal to 6 months prior to diagnosis; not less than or equal to 6 months but 7 to 18/36 months prior to diagnosis; no PM, but prevalence or diagnostic bilateral

mammography 7 to 18/36 months prior to diagnosis; or no mammography at all 7 to 18/36 months prior to diagnosis. Further exposures are defined in relation to the date of invasive or in situ cancer: mastectomy less than or equal to 39 weeks later; axillary dissection less than or equal to 39 weeks later; chemotherapy less than or equal to 16 weeks later; or radiotherapy less than or equal to 52 weeks later.
Results: Rates of additional mammography per 10^5 women with PM decreased from 2001–2010 among all age groups. Rates of breast ultrasound increased from 2001–2010 only among those ages 42–49, from 23,544 (23.54 percent) to 31,173 (31.17 percent). Rates of breast biopsy decreased among those 42 to 74 from 2001–2010; ages 42–49 (3.05 percent to 2.59 percent); ages 50–59, (1.79 to 1.28 percent); ages 60–69, (1.76 percent to 1.28 percent); and ages 70–74, (1.76 percent to 1.45 percent).
Conclusion: We have computed overall costs of PM and overall costs of cancer care stratified by periodic mammography and cancer stage. Among cases of invasive breast cancer, PM was associated with approximately 5 percent reduction in intravenous chemotherapy and mastectomy but no reduction in radiotherapy or axillary dissection. Among cases of ductal carcinoma in situ, there was no association between PM and reduction in mastectomy, axillary dissection, or radiotherapy. Analyses will be presented.

Low risk of colorectal cancer in India, but rising rates in East Asia

Pathy S1, Lambert R2, Sauvaget C2, Sankaranarayanan R2
1All India Institute of Medical Sciences, New Delhi, India; 2International Agency for Research on Cancer, Lyon, France

Background: During the last three decades, the incidence of colorectal cancer was at a low level in urban and rural populations in India, when compared to figures observed in developed countries of North America and Europe. This study aims to describe the time trends of incidence and mortality, as well as the survival rates of colorectal cancer in India.
Methods: This ecological study uses incidence data extracted from selected Indian cancer registries in the volumes of Cancer Incidence in five continents as main outcome measures.
Results: Low and stable incidence and mortality rates from colon and rectum cancers were observed in India in both men and women. However, this low incidence rate was associated with a low 5-year relative survival rate.
Conclusion: It is quite likely that the prevailing environmental factors and lifestyle including a reduced consumption of sugars, calories, and fat rich food; an increased consumption of vegetables and fruits; and adequate physical activity with avoidance of overweight and obesity are responsible for the low risk of colorectal cancers. In contrast, the low survival even for localized cases suggests severe deficiencies in early diagnosis and effective treatment in India. A strategy to control the disease in India, based on (1) improving awareness of the risk factors for colorectal cancer while keeping the traditional lifestyle and (2) investments in early diagnosis and adequate treatment should be implemented. However an organized, population-based screening of colorectal cancer may not prove cost-effective, given the low burden of colorectal cancer.

Invasive cervical cancer incidence and mortality rates in young Canadian women: 1970–2007

Popadiuk C[1], Stankiewicz A[2], Dickinson J[3], Pogany L[2], Miller AB[4], Onysko J[2]
[1]Memorial University, St John's, Newfoundland, Canada; [2]Public Health Agency of Canada, Ottawa, Ontario, Canada; [3]University of Calgary, Calgary, Alberta, Canada; [4]University of Toronto, Toronto, Ontario, Canada

Background: Pap smear screening has decreased invasive cervical cancer (ICC) incidence and mortality. The utility of screening young women is questionable given the likelihood of pre-cancer regression and potential harm from further intervention. This study aimed to evaluate the incidence and mortality rates of ICC in women aged 15 to 29 years since the uptake of screening in the 1970's.
Methods: Incidence and mortality for ICC cases were obtained from the Canadian Cancer Registry for the period from 1970 to 2007. Relevant data were classified by age group at diagnosis or death (15 to 19, 20 to 24, and 25 to 29) and 5-year intervals of diagnosis or death (1970 to 2007). Incidence was further analyzed according to histology.

Results: While the incidence of ICC is rare and remained relatively constant from 1970–74 to 2005–07 amongst 15- to 19-year-olds, there was a decline in incidence among 20- to 24-year-olds by 63.4 percent to 1.2 cases per 100 000 from 1975–79 to 2005–07 and among 25- to 29-year-olds by 43.5 percent to 6.3 cases per 100,000 from 1980–84 to 2005–07. Deaths among 15- to 19- and 20- to 24-year-olds are rare events, but mortality in 25- to 29-year-olds has declined by 44.1 percent to 0.5 cases per 100,000 from 1975–79 to 2005–07. As for the histology of cancers, among 20- to 24-year-olds there is a decline in total cancers and squamous cell carcinoma, whereas among 25- to 29-year-olds there is a decline in total cancers and squamous cell type and an apparent increase in adenocarcinoma.
Conclusions: ICC in adolescents is rare and may not justify population based screening. Screening appears to have affected the incidence for 20- to 29-year-old women and the incidence and mortality in 25- to 29-year-olds.

Efficacy of cervical cancer screening to prevent cervical cancer mortality among women ages 55 to 79 years: A population-based, case-control study

Rustagi AS[1], Kamineni A[2], Weinmann S[3], Reed SR[1,4], Newcomb PA[1,4], Etzioni RB[1,4], Weiss NS[1,4]
[1]University of Washington, Seattle, Washington, United States; [2]Group Health Research Institute, Seattle, Washington, United States; [3]Kaiser Permanente Northwest, Portland, Oregon, United States; [4]Fred Hutchinson Cancer Research Center, Seattle, Washington, United States

Background: Cervical cytology screening has been consistently observed to reduce cervical cancer incidence and mortality among reproductive-age women. At present, there are but limited data regarding the utility of screening older women for cervical cancer. Older women with adequate negative screening histories may experience such a low incidence rate of cervical neoplasia that continued screening would offer little benefit. However, recent data from Kamineni and colleagues suggest that cervical cytology screening is associated with a 77-percent reduction in cervical cancer incidence among women ages 55–79 years. Whether cytology screening reduces cervical cancer mortality to a similar degree has not been well evaluated in older women.
Methods: Among women enrolled in two United States health plans, this population-based case-control study compares screening histories of women ages 55–79 years who died of cervical cancer during 1980–2010 to those who did not. Cases are identified from tumor registries. Controls are a sample of female enrollees with intact cervices, matched 2:1 to cases on health plan, age, and enrollment duration prior to case diagnosis date. The primary exposure is receipt of cytology screening during the detectable pre-clinical phase (DPP), the period during which a cervical lesion is detectable by cytology but is not yet symptomatic. Prior research suggests that the DPP lasts no longer than 5–7 years in women ages 55–79. Receipt of screening is ascertained for each case and her matched controls during the 7 years prior to the case's symptom onset date (if clinically-detected) or screening date (if screen-detected). A deficit of screening among cases relative to controls should be observable during the DPP if screening is beneficial.
Analysis: We will use multivariate conditional logistic regression to estimate the odds ratio (OR) of cervical cancer mortality associated with screening receipt during the DPP. Sensitivity analyses that vary the start of the DPP in 6-month intervals will also be performed. Three exploratory analyses are planned: (1) stratification by age at diagnosis, less than 65 or at least 65 years old; (2) restriction to squamous cell carcinoma cases; and (3) stratification by year of diagnosis, pre- versus post-1999, since a major advance in cervical cancer treatment occurred in 1999.
Significance: Despite its public health significance, no unbiased, analytic study has quantified the efficacy of cytological screening to reduce cervical cancer mortality among older women. The present study may provide insight into whether to screen such women, by cytology or by the more sensitive method of human papillomavirus DNA screening.

Cancer registries and disease staging in the Portuguese Region of Alentejo: Patient classification systems, quality of coding, and incentives

Santana R[1], Matos R[2], Lopes T[2]
[1]National School of Public Health, Lisbon, Portugal; [2]Regional Health Services of Alentejo, Alentejo, Portugal

Background: Alentejo is one of the five Health Administrative Regions of Portugal. With 511,679 residents, this region is characterized by a low educational level (only 5 percent have higher education), high old-age dependency rate (140 percent of the Portuguese average), and weak economic competitiveness (in 2007, *gross domestic product* per capita in *purchasing power parity* terms was 73 percent of the European Union).
Methods: Prior studies have shown that Alentejo presents lower survival rate (1, 3, and 5 years) in prostate, colon and rectal, stomach, and respiratory cancers when compared to other regions of Portugal. The hypothesis of late detection of cancers was studied through the analysis of disease staging. The information available included two main data sources: the national hospital discharge database and Regional Oncology Register (ROR), between 2002 and 2006.
Results: While staging by pathology was registered in 82 percent of all episodes, staging by clinical tumor, node, metastasis system was present only in 17 percent of the 11,697 episodes. We also found 143 different notation forms of staging registries.
Conclusion: Based in our results and believing that cancer data is essential for epidemiological studies, health care planning and priority setting, we discuss and recommend three major actions to improve cancer registries in Alentejo. First it is necessary to standardize notation (through electronic limitations on coding); second, available data should be merged (diagnosis-related groups [DRG] and ROR databases); and third, the link between healthcare financing and the quality of registers (DRG episodes should only be payed when the information captured presents good level of completeness, validity, and reliability).

Reducing the burden of overpapulation: Achieving more by doing less

Schottinger J, Kanter M, Palmer-Toy D
Southern California Permanente Medical Group, Pasadena, California, United States

Background: Evidence-based guidelines from the United States Preventive Services Task Force recommend cervical cancer screening with Pap smears with a 3-year interval for women ages 21 to 65. In 2006, 1 out of 5 women were not screened within the 3-year interval, while many others were screened annually. We term this too-frequent screening “overPapulation.” Kaiser Permanente Southern California (KPSC) provides comprehensive prepaid medical care to 3.6 million socioeconomically diverse members, with an emphasis on evidence based medicine and a commitment to prevention and wellness. In 2006, KPSC screening rates for cervical cancer in women ages 21–65 were 79 percent. A systematic approach was initiated to increase screening rates while lowering rates of too-frequent, unnecessary testing.
Methods: We defined “overPapulation” to include women ages 21–65 who were Pap- (and human papillomavirus-, if over 30) negative but had a repeat test within 20 months. Cervical cancer screening rates and overPapulation rates were measured by department and provider, with unblinded report feedback provided quarterly by local initiative champions. Intensive educational materials were developed for both physicians and patients. Efforts to increase screening rates included mailed outreach letters, inreach prompts for care gaps with an electronic medical record, and reminder phone calls.
Results: The overPapulation rate dropped from 42 percent in 2006 to 12 percent by year end 2008. Initial rates of overPapulation ranged from 32 percent in primary care departments to 52 percent in obstetrics-gynecology departments. During the same time frame, the rate of cervical cancer screening rose from 79 percent to 87 percent. No change was seen in stage of diagnosis of cervical cancer. Visits to primary care and gynecology for women ages 21–65 declined by about 75,000 (6 percent) over a year, as compared to a control group of men ages 21–65.
Conclusion: Unnecessary, early testing with Pap smears were dramatically reduced by a program of education, local physician champions in each medical center, and frequent measurement with unblinded feedback. Cervical cancer screening rates rose during the same period. Substantial savings in office visits and lab costs were also achieved.

Routine sub-classification of mammographic suspicious lesions potentially can reduce the harm of unnecessary breast biopsy

Stark A[1], Yan XW[1], Naimei T[2], Fernandez-Madrid F[2]
[1]Geisinger Center for Health Research, Geisinger Health System, Danville, Pennsylvania, United States; [2]Karmanos Comprehensive Cancer Institute, Wayne State University, Detroit, Michigan, United States

Background: Presently, women diagnosed with mammographic suspicious lesions (BIRADS™ 4) are recommended to undergo breast biopsy for pathologic evaluation. About 80 percent of these women are diagnosed with benign conditions of the breast of no clinical significance. The annual economic cost of these unnecessary biopsies has been estimated at $3.5 billion; the psychological impact on women and their families is large and negative, and there are possible complications due to scarring. Concerns about negative breast biopsies have been expressed in terms of over-diagnosis and interventions that can be disfiguring and expensive. We report findings from a sequential case series study of women diagnosed with BIRADS™ 4.
Methods: We identified a total of 1,447 cases from the radiology database that was linked to electronic health records, and data on pathology outcome, clinical and demographic risk factors for breast cancer were downloaded. We used multivariate logistic regression to estimate the risk of malignancy within 4A and 4B sub-classifications. Statistical analyses were conducted using SAS package (v 9.2).
Results: Mammograms of 268 (18.5 percent) were sub-classified as 4A, 112 (7.7 percent) as 4B, 75 (5.2 percent) as 4C, and 992 (68.5 percent) were not sub-classified. Malignancies were diagnosed in 6.7 percent (n=18) of women with 4A, 25 percent (n=28) with 4B, and 80.0 percent (n=56) with 4C; 18.2 percent (n=183) of women without sub-classifications were diagnosed with malignancies. Among women with 4A or 4B sub-classifications, the likelihood for malignancy increased significantly for women 55 years old or older (OR=7.5, 95 percent CI 2.09-27.02, P=0.02), but no significant association was detected for the younger age group (P> 0.56).
Conclusion: Given the harm of biopsy and the wide difference in the prevalence of malignancy, routine sub-classification of BIRADS™ 4 is recommended, especially for women 55 years old or older. Our findings further confirm that many breast biopsies can be avoided; however, unless a method that is less invasive but has the same level of validity and reliability as breast biopsy is developed, the present diagnostic guidelines and practices most likely will remain unchanged.

High-grade cervical abnormalities and cancers in women with a negative Pap smear with and without an endocervical component: A cohort study with 10 years of follow-up

Sultana F[1], English D[1], Simpson JA[1], Saville M[1], Gertig D[2]
[1]University of Melbourne, Victoria, Australia; [2]Victorian Cytology Service, Victoria, Australia

Background: The proportion of Pap smears with an endocervical component has decreased in Australia recently, and this raises concern as to whether this affects detection of high-grade abnormalities, including cancers. We used data from the Victorian Cervical Cytology Registry to determine whether women whose negative smears do not have an endocervical component had a higher incidence of histologically confirmed high-grade abnormality (HGA) or cancers than women whose smears contained an endocervical component and whether any association varied according to the presence or absence of an endocervical component in previous smears.
Methods: Women 18–69 years of age who had a negative Pap smear between 1 January 2001 and 31 December 2010 (entry smear) and at least one subsequent smear were included. Smears were classified based on the presence of an endocervical component in the entry smear. Women were followed from the date of entry smear till the date of histological diagnosis of the first HGA or the date of the last smear, whichever came first. Incidence rates for all HGA and cancers were compared for women whose smears had an endocervical component, overall and by age group (under 25 years old, 25–50 years old, and more than 50 years old). Rate ratios (RR) adjusted for age were estimated using Poisson regression. Interactions with the status of previous smears were fitted.
Results: A total of 1,141,104 women were followed for 6,944,257 person years. The incidence rates were 1.98 per 1,000 person years for HGA and 0.02 per 1,000 years for cancers. The adjusted RR for smears without an endocervical component was 0.78 [95 percent CI: 0.74 -0.81] for HGA and 1.29 [95 percent CI: 0.89 to 1.84] for cancers. The RRs varied little according to the status of previous smears. For women 25–50 years old, the RR was 0.78 [95 percent CI: 0.74 to 0.84] for HGA and 1.66 [1.04 to 2.64] for cancers. For women who were diagnosed

with cancer, those whose smears had an endocervical component had a longer median follow-up [4.7 versus 3.6 years] and more subsequent smears [44 percent versus 38 percent had three or more] and a higher proportion had a cytological diagnosis of HGA [80 percent versus 75 percent].
Conclusion: Women with a smear without an endocervical component had lower rates of HGA but higher rates of cancers than did women whose smear had an endocervical component.

The effect of introduction of immunochemical faecal occult blood testing on colorectal cancer incidence

Ventura L, Mantellini P, Grazzini G, Castiglione G, Buzzoni C, Rubeca T, Romeo G, Sacchettini C, Paci E, Zappa M
Cancer Prevention and Research Institute (ISPO), Florence, Italy

Background: The efficacy of colorectal cancer screening based on the faecal immunochemical test (FIT) in reducing the incidence of colorectal cancer (CRC) is under debate. In the district of Florence, an organized screening programme for CRC based on biennial FIT has been running since the early 1990s. The aim of this study is to analyze the risk of developing a CRC for subjects performing FIT in comparison with those who did not perform the test in the same period.
Methods: Two cohorts were analyzed: the first included subjects who had performed their initial FIT between 1993 and 1999, and the second was composed of unscreened subjects from the same period. We performed a Kaplan Meier analysis and a Cox regression analysis, in order to evaluate the risk of developing a colon-rectal cancer.
Results: The screened cohort included 6,961 subjects, who had performed their initial FIT during the period 1993–1999. There were 26,285 subjects in the unscreened cohort. The Cox analysis, adjusted for sex and age, showed a reduction in CRC incidence of 22 percent (HR = 0.78, 95 percent CI: 0.65-0.93) in the screened cohort in comparison with the unscreened one. The observed and expected CRCs in the screened cohort were 141 and 180.2, respectively, and therefore for every 1,000 people screened the screening activity had prevented about 5.6 CRC cases.
Conclusion: Our results support the hypothesis that the implementation of CRC screening based on a single FIT every 2 years produces in the after an average follow-up period of about 11 years a significant decrease in CRC incidence.

Prognostic value of tumor characteristics among participants in a breast cancer screening program, 2007–2011

Vidal C[1], Garcia M[1], Benito L[2], Guma A[1], Ortega R[2], Moreno V[2]
[1]Catalan Institute of Oncology, Barcelona, Spain; [2]Bellvitge Hospital, Barcelona, Spain

Background: The frequency of interval cancers and the estimation of the proportional incidence are currently recommended as the most reliable indicators of screening sensitivity. Identifying interval cancers is not easy due to unreliable or uncompleted information, particularly if a population-based cancer registry is not available. The identification and the radiological classification of interval breast cancers entail a lot of effort with poor results. However, a review of interval cancers can be useful to identify the characteristics of the fastest growing tumors and their determinants.
This study aimed to compare the prognostic value of tumor characteristics by type of breast cancer (clinically detected cases and screen-detected cases).
Methods: We conducted a case-case study within the cohort of women (n = 170,000) in the Costa de Ponent Breast Screening Program aged 50 years to 69 years and who were screened between January 1, 2007, and June 30, 2011. A clinically detected cancer (CDC) was defined as a breast cancer diagnosed within 24 months after a negative screening mammogram; no difference was established between true interval cancers and false negative cancers. The breast screening program database included data on patient identification, age, number of previous attendance to screening, appointment dates, and family history of breast cancer. The following information was available in women diagnosed with a breast cancer: date of diagnosis, grade, mitotic index, histology and molecular subtypes (luminal A, luminal B, Her2, and triple negative). Multivariate logistic regression models were

performed to identify prognostic characteristics associated with the type of breast cancer (screen-detected cases versus CDC). Adjusted odds ratios (OR) and their 95 percent confidence intervals (95 percentCI) were estimated.
Results: We analyzed 736 invasive tumors, 137 (18.6 percent) CDC and 599 (81.4 percent) screening-detected. CDC were of higher grade (p=0.02) and higher mitotic index (p=0.000) than screen-detected breast cancer. CDC were diagnosed at a younger age (OR=0.92 IC=0.89 to 9.86) and were more likely to be subtype Her2 (OR = 2.29, 95 percent CI = 1.004 to 5.23) or triple negative (OR = 2.08, 95 percent CI = 1.12 to 3.87) compared with screen-detected tumors.
Conclusion: Screen-detected cancers were of lower grade and mitotic index compared with CDC. Women with CDC were younger and had more frequently negative hormonal receptor subtypes (Her2 or triple negative). The findings suggest a need for more specific screening modalities and different approaches for early detection of faster- and slower-growing tumors.

Systematic review of extracolonic findings by computed tomography colonography

Wernli KJ[1], Rutter CM[1], Dachman AH[2], Zafar HM[3]
[1]Group Health Research Institute, Seattle, Washington, United States; [2]University of Chicago Medical Center, Chicago, Illinois, United States; [3]University of Pennsylvania, Philadelphia, Pennsylvania, United States

Background: Computed tomography (CT) colonography can opportunistically detect significant extracolonic findings when used for colorectal cancer screening. However, whether there is a net benefit through detection of asymptomatic disease or a net harm through work-up of false-positive findings is unclear, but important to understanding the impact of population-based screening with CT colonography. We conducted a systematic review of the literature to assess the impact of extracolonic findings found on CT colonography and the diagnosis of cancer.
Methods: We searched PubMed for English-language articles published between January 1, 1994, and December 31, 2010. Articles were eligible for inclusion if they reported original data describing CT colonography and associated extracolonic findings. We targeted findings associated with high mortality and likely to lead to follow-up including indeterminate masses of the kidney, lung, liver, pancreas, and ovary suspect for neoplasm. For each targeted organ, we calculated the median prevalence, positive predictive value (PPV), and false-positive rate of cancer and a pooled false-positive rate across studies.
Results: Of 91 publications initially identified, 27 were eligible for inclusion. Publications included in this systematic review represented a range of sample sizes, participant ages, and geographic populations from North America, Europe, Australia, and Asia. Overall, indeterminate renal masses on CT colonography were the most likely findings to correspond to malignancy on follow-up (median PPV 20.5 percent, pooled false-positive rate 0.8 percent). In contrast, indeterminate masses of the lung, liver, pancreas, and ovary were unlikely to correspond to malignancy (median PPV 0–3.8 percent); the highest pooled false-positive rate was for indeterminate masses of the ovary (2.5 percent). We estimated the probability of detection of potentially significant extracolonic findings from CT colonography as 36 per 1,000 for men and 58 per 1,000 for women.
Conclusion: Indeterminate renal masses newly detected on CT colonography are predictive of renal cancer and warrant further follow-up to provide a definitive diagnosis. Conversely, indeterminate masses of the lung, liver, pancreas, and ovary newly detected on CT colonography are less likely to correspond to malignancy and could be followed conservatively. CT colonography has the potential to improve overall adherence rates to screening. Screening programs promoting CT colonography as a tool for colorectal cancer screening should be aware of the potential burden of false-positive results among the most common extracolonic findings.

Comparison of a metropolitan Australian breast screening program to international contexts: False negatives, false positives, assessment procedures, and cancer detection

Winch C[1], Sherman K[1,2], Boyages J[1,2,3]
[1]Macquarie University, Sydney, New South Wales, Australia; [2]Westmead Breast Cancer Institute, Westmead, New South Wales, Australia; [3]Macquarie University Cancer Institute, Sydney, New South Wales, Australia

Background: Randomised controlled trials (RTCs) demonstrate that screening mammograms reduce mortality from breast cancer. However, recent debates in the scientific and popular media have portrayed screening as unduly burdening women with the medical and potential psychological costs of false positives. We aimed to examine the magnitude of medical burden in the context of a large no-cost Australian program in western Sydney.
Methods: Two hundred thirty-two thousand six hundred seventy-three women aged 40 and over underwent 806,415 screening mammograms at BreastScreen New South Wales (NSW) Sydney West between 1993 and 2008. Outcomes related to false negatives and false positives, the medical burden of assessment, and cancer detection were compared to the United States Preventative Services Task Force systematic review of breast screening.
Results: False-negative rates per 1,000 screens across age groups were similar to those found in RCTs, as were rates of screen-detected invasive cancer and ductal carcinoma in situ (DCIS). However, false positives were substantially lower with a consequent reduction in the rate of assessment images.
Conclusion: BreastScreen NSW Sydney West had similar cancer detection and false negative rates to the summary presented in the United States Preventative Services Task Force systematic review but a substantially lower burden of false positives and additional imaging. Media debate regarding breast screening may be based on programs with higher burden than is feasibly achievable.

Does screening explain international and socio-economic differences in survival from breast cancer between England and Australia?

Woods LM[1], Rachet B[1], O'Connell D[2], Coleman MP[1]
[1]Cancer Research United Kingdom Cancer Survival Group, London School of Hygiene and Tropical Medicine, London, United Kingdom; [2]Cancer Council New South Whales, Sydney, New South Wales, Australia

Background: We have shown a significant 6-percent difference in 5-year breast cancer survival between Australia and England for women in the screening age range who were diagnosed during 1996–99. The relatively low intensity of breast screening in England is one possible explanation for lower survival in England. We also found that the survival gradient between rich and poor is greater in England than in Australia. Little is known about how this gradient is modified by screening in either country. Previous analyses of cancer survival in populations screened for breast cancer have examined interval cancers, compared survival in attendees versus never attendees, or screen-detected versus non-screen detected women. Few studies have assessed the impact of screen-detection upon population-based survival. A review conducted in the United Kingdom in 2005 concluded that more detailed data were required—in particular, screening invitations linked to mortality records—to obtain a better understanding of the effect of screening on survival. We aimed to determine the survival of screen-detected compared to non-screen-detected breast cancer in women resident in the Government Office Region of West Midlands, England and in the state of New South Wales, Australia.
Methods: We obtained individual records of incident breast cancers, matched to each woman's screening history if she had one. The data were obtained by linking individual tumour records from population cancer registries with the English National Health Service Breast Screening Programme (NHSBSP) and with BreastScreen New South Wales (BSNSW). We report analyses of breast cancer-specific survival by screening status amongst women aged 50–69 years who were diagnosed 1996–2006. From these data (19,616 incident breast tumours in New South Wales, and 15,882 tumours in the West Midlands) we derived relative survival for four groups of women: those whose cancers were screen-detected; those whose cancers were interval cancers; those who never attended for screening; and those who were lapsed attendees. We compared relative survival for each group between New South Wales and the West Midlands.
Results: We report survival 1 and 5 years after diagnosis by age, extent of disease, and socio-economic status (SES), estimated with SES-specific life tables for each region. We used recently developed methods to adjust for lead-time and length biases. We report estimates of the excess hazard ratio between women with screen-detected and non-screen-detected cancers in New South Wales and West Midlands and the estimated annual number of deaths that could be avoided within 5 years of diagnosis if universal screening coverage were achieved in each region.

Evaluating New Technologies and Their Readiness for Incorporation into Organized Screening Programs

BIEMR: An open source software surveillance system built on an EMR framework

Abdolell M[1], Doyle G[2], Payne JI[1], Foley T[3], Caines JS[1,3], Duggan R[3], Barrington G[2]
[1]Dalhousie University, Halifax, Nova Scotia, Canada; [2]Breast Screening Program of Newfoundland and Labrador, St. John's, Newfoundland and Labrador, Canada; [3]Nova Scotia Breast Screening Program, Halifax, Nova Scotia, Canada

Background: Data information systems developed when organized breast screening programs were first established in Canada in the 1980s continue to be used today. In the current climate of tight budgetary restraints and prohibitively expensive and inadequate proprietary information systems, there is a common need for an electronic medical record (EMR) that establishes standards for automated clinical reporting and programmatic reporting, benchmarking, surveillance, and research. We have developed a modern and robust information system that accommodates both the clinical needs of mammographers as well as the reporting and surveillance needs of breast screening programs and also facilitates research and decision tool development that informs evidence-based decision making.
Methods: Collaboration between clinicians, breast screening program directors, and academics has led to the development of the Breast Imaging Electronic Medical Record (BIEMR). BIEMR is an integrated solution employing open source software (OSS), including the Caisis platform for cancer data management, the R language for statistical computing, and the LaTeX system of document preparation. In addition to supporting patient management, BIEMR facilitates the standardization and collection of data elements and has been developed to support system-level surveillance functions such as automated reporting (e.g., wait times, national performance indicators), decision tools (e.g., Gail model), and statistical modeling techniques (e.g., statistical process control).
Discussion: The opportunities for cost savings and latitude for customization for breast screening programs using BIEMR are immense due to the OSS model. An existing international community of institutions and developers who have actively adopted Caisis ensures long-term sustainability of the underlying cancer data management system, and the establishment of a governance structure and a community of practice for BIEMR ensure active collaboration and continued development.
The system is being adopted by the Nova Scotia Breast Screening Program, the Breast Screening Program for Newfoundland and Labrador, and the Northwest Territories. Other provincial breast screening programs from across Canada have also shown interest.
Conclusion: BIEMR caters to the needs of numerous stakeholders including clinicians, program managers, decision makers, and researchers. It is a clinical information system that satisfies the needs of both screening and diagnostic mammography that standard commercial products do not adequately address and uniquely integrates capabilities for reporting and surveillance. The integration of a clinical EMR specifically focused on breast health with strong capabilities for reporting and surveillance makes BIEMR a unique and powerful tool for clinicians, researchers, and policy makers alike.

3-D ultrasound: Utilizing a new technology in diagnostic breast imaging to reduce wait times in an organized breast screening program

Caines JS[1,2,3], Duggan RD[2], Iles SE[1,3], Payne JI[1,2], Foley TJ[2]
[1]Dalhousie University, Halifax, Nova Scotia, Canada; [2]Nova Scotia Breast Screening Program, Halifax, Nova Scotia, Canada; [3]*Queen Elizabeth II Health Sciences Centre*, Halifax, Nova Scotia, Canada

Background: The implementation of a new technology in a diagnostic breast-imaging department has had a positive effect on wait times in the Nova Scotia Breast Screening Program (NSBSP). The Diagnostic Breast Imaging Centre of the *Queen Elizabeth II Health* Sciences Centre (QEII) in Halifax, Nova Scotia, is the largest diagnostic mammography site in Nova Scotia. In 2010 the QEII handled 35 percent (1,427/4,040) of all abnormal referrals from the NSBSP and 42 percent (6,388/15,238) of all diagnostic mammography requests in Nova Scotia. From

2010/04-2011/01Q1 the wait time (90th percentile) for diagnostic mammography at the QEII increased from 22 to 85 days (target: 14 days). During the same time period, the wait time for work-up mammography for abnormal screens rose from 22 to 34 days (target: 35 days). Contributing to increasing wait times is the increase in diagnostic clients under age 40 (u40). The number of u40 clients at the QEII grew from 1,056 to 1,403 between 2000 and 2010. The breast cancer rate in individuals u40 at the QEII is very low, approximately 0.1 percent. In contrast, symptomatic clients over 40 had a cancer rate of 6 percent. A solution was needed for the QEII to appropriately handle u40 clients, while maintaining appropriate care and timely access for women with abnormal results from the NSBSP.
Methods: Our solution was to use 3-dimensional (3-D) ultrasound to service u40 clients while maintaining the standard of care for this group. This group has been removed from the diagnostic workflow that requires radiologist interaction. This allows more time for patients over 40. u40 clients referred with a palpable abnormality or tissue thickening have a technologist-performed 3-D ultrasound immediately followed by a limited clinical breast exam and a standard, two-view mammogram. Prior to her mammogram, any client with a palpable finding has a radiopaque marker placed on the skin where the abnormality is felt. Spot compressions over the palpable area are also performed for clients with a palpable finding. A screening radiologist reports the 3-D ultrasound and mammogram together that day. If the findings are abnormal, the patient is recalled and has additional diagnostic testing or is referred to a Breast Surgery clinic based on a clinical management algorithm for the findings. If the images and clinical examination are normal, no additional testing is required.
Results: Since this change has been implemented, the wait time for diagnostic mammography has dropped from 85 to 72 days and the wait for work-ups has dropped from 34 to 28 days.

The Scottish Cervical Cancer Prevention Programme

Campbell C[1], Gallagher M[1], Weller D[1], Cubie HA[2], Cuschieri K[2], Sinka K[3], Robertson C[4], Cruickshank M[5], and on behalf of the Scottish HPV Investigators' Network (SHINe)
[1]The University of Edinburgh, Edinburgh, Scotland, United Kingdom; [2]Scottish Human Papilloma Virus Reference Laboratory, Health Protection Scotland, Edinburgh, Scotland, United Kingdom; [3]Health Protection Scotland, Glasgow, Scotland, United Kingdom; [4]University of Strathclyde, Glasgow, Scotland, United Kingdom; [5]University of Aberdeen, Aberdeen, Scotland, United Kingdom

Background: Internationally, cervical cancer is the second most common cancer in women and kills around 20 women in the United Kingdom each week. The incidence has been greatly reduced through organised screening, most of which is delivered in primary care. More recently human papilloma virus (HPV) vaccination has provided opportunity for primary prevention. This study aims to assess and model the impact of HPV 16/18 immunisation on the performance of current cervical screening performance and the effectiveness of alternative cervical screening strategies to optimise cancer prevention in the HPV immunisation era in Scotland.
Methods: This is a multi-method 5-year research programme. Routinely collected data from the Scottish Cervical Call-Recall System (SCCRS) is being used to evaluate the impact of HPV immunisation on the performance of cytology to identify cervical disease. In parallel, routinely collected data from the National Colposcopy Clinical Information and Audit System (NCCIAS) will be used to evaluate the impact of HPV immunisation on the performance of colposcopy. In order to investigate the value of HPV testing as a primary screening test in vaccinated cohort of women, HPV testing is being carried out on approximately 5,000 20-year-old women attending for cervical screening and those who test positive for high-risk HPV types referred for colposcopy. Four hundred 20-year-old women attending for colposcopy during two calendar periods (2010–11 baseline unvaccinated cohort and 2013–14 vaccinated cohort) in Grampian and Lothian are being recruited into a study where at colposcopy, a sample will be taken for HPV genotyping and data from their colposcopy examination collected. Presence of individual HPV types will then be compared with identifying colposcopic features. The attitudes and understanding of young women in Scotland about HPV vaccination and cervical screening are being explored through a national survey of women aged 18–22 who have just entered or are soon to enter the screening age-group. Finally, data from all studies will be used to populate and update an existing disease progression model.

Results: We will provide preliminary data and updates from individual components of this research programme and describe how Scotland is developing integrated cervical cancer prevention services, making use of Scotland's ability to link data through the Community Health Index (CHI).
Conclusion: Scotland has invested in the building blocks that should provide a comprehensive and integrated cervical cancer prevention programme. Scotland's approach to integrated services potentially provides a model for other international settings.

COMPASS: A randomised controlled trial of primary HPV DNA testing for cervical cancer screening in Australia

Canfell K[1], Marion Saville M[2]
[1]Cancer Council New South Wales, Woolloomooloo, New South Wales, Australia; [2]Victorian Cytology Service, Melbourne, Victoria, Australia

Background: The introduction of human papillomavirus (HPV) vaccination has been part of the driver for reconsideration of optimal screening approaches in Australia. When considering changes to the National Cervical Screening Program, careful attention will need to be given to the safety and effectiveness of any new cervical screening technologies, appropriate screening interval, and age of starting screening, as well as acceptability of changes to women and practitioners.
Methods: COMPASS is a proposed randomised controlled trial of primary HPV DNA testing for cervical screening in Australian women aged 25–64 years. The pilot study will involve recruiting 5,000 women attending for regular cervical screening at participating general practitioner (GP) and sexual health clinics in the state of Victoria. Consenting women will agree to have a liquid-based sample collected, which will be returned to a centralised processing laboratory and randomised into one of the three study arms: (1) 3-yearly image-read cytology screening with reflex HPV triage testing for low-grade smears; (2) 6-yearly HPV screening with type 16/18 (+/-45) genotyping and cytology triage of intermediate-risk women; and (3) 6-yearly HPV screening with type 16/18 (+/-45) genotyping and dual-stained cytology (with p16/Ki67) triage of intermediate-risk women. Safety monitoring will be performed in HPV testing arms, and a 10-percent random sample of screen-negative women will be referred for colposcopy. The aims of the pilot will be to assess participant acceptance of the randomization process and the use of longer routine screening intervals; to assess the operational feasibility of laboratory processing procedures; to quantify test positivity rates for the primary screening test in each arm in women under 30 years of age and over 30 years of age; and to assess preliminary cross-sectional sensitivity and specificity results. Results from the pilot will inform the main trial which will involve recruiting up to 100,000 women and will aim to assess differences in the cumulative rates of histologically confirmed cervical intraepithelial neoplasia 3+ over various durations of follow-up in screen-negative women from each arm.
Conclusion: There is a need to focus on building the evidence base required for an integrated approach to decision making for identifying changes to the National Cervical Screening Program. COMPASS will provide both cross-sectional outcomes from the initial round of screening and longitudinal outcomes from subsequent screening rounds, which will provide key information on the safety and effectiveness of longer-interval primary HPV screening in Australia.

Evaluation of the first year of the Ontario Breast Screening Program: High Risk Screening Program

Chiarelli AM[1,2], Marrett LD[1,2], Muradali D[1], Majpruz V[1], Carroll JC[3], Eisen A[4], Meschino W[5], Shumak RS[1], Warner E[4], Rabeneck L[1]
[1]Cancer Care Ontario, Toronto, Canada; [2]University of Toronto Dalla Lana School of Public Heath, Toronto, Canada; [3]Mount Sinai Hospital, Toronto, Canada; [4]Sunnybrook Health Sciences Centre, Toronto, Canada; [5]North York General Hospital, Toronto, Canada

Background: Evidence suggests that women at high risk of breast cancer such as BRCA1/2 mutation carriers benefit from breast cancer screening that includes magnetic resonance imaging (MRI) of the breast. The Ontario Breast Screening Program (OBSP) has screened average-risk women 50 to 74 years of age since 1990 and was expanded in July 2011 to screen women aged 30 to 69 considered to be high risk with annual MRI in addition to mammography. This study will describe the program design and evaluation of screening performance measures among women screened in the first year of the High Risk Screening Program.
Methods: Based on recommendations from the Ontario Program for Evidence-Based Care and The Ontario Health Technology Advisory Committee, Cancer Care Ontario engaged an expert panel to design a screening program for women aged 30 to 69 at high risk for breast cancer. The High Risk Screening Program was implemented in 28 screening centres that provide referrals for genetic assessment and offers screening breast MRI, mammography, and diagnostic services. This study will examine the cohort of women screened between July 2011 and June 2012. A woman is considered to be at high risk if she: has a known mutation in BRCA1/2 or other gene predisposing to a markedly elevated breast cancer risk; is an untested first-degree relative of a carrier of such a gene mutation; has a family history consistent with a hereditary breast cancer syndrome and estimated personal lifetime cancer risk greater than or equal to 25 percent; or had radiation therapy to the chest before age 30 and at least 8 years previous. Performance measures such as participation rate, recall rate, and cancer detection rate will be compared by high risk category from information routinely collected by the OBSP.
Results: The number of women referred to the program has increased steadily by month. During the first 8 months, 698 women were referred directly by their physician with most (61.3 percent) having a known gene mutation. Of the 2,547 women who have received genetic assessment, 773 (30.3 percent) women were confirmed eligible, with the majority (71.3 percent) having a lifetime cancer risk greater than or equal to 25 percent. Of the 1,471 eligible high-risk women, 600 have been screened and 193 (32.2 percent) had an abnormal screen.
Conclusion: The design and performance measures will be presented for the first year of the High Risk Screening Program. To our knowledge, this is the first organized screening program for women at high risk of breast cancer.

Sensitivity of endoscopic and radiographic screening for gastric cancer

Hamashima C[1], Okamoto M[2], Kishimoto T[2]
[1]National Cancer Center of Japan, Tokyo, Japan; [2]Tottori University, Yonago, Japan

Background: Although radiographic screening for gastric cancer has been conducted in Korea and Japan, it is anticipated that endoscopy will become a new screening method. The evidence that endoscopic screening reduces mortality from gastric cancer is insufficient.
The sensitivities of endoscopic and radiographic screening for gastric cancer were compared.
Methods: There were 56,676 screenings for gastric cancer using radiography and endoscopy from April 2002 to March 2007 in Yonago, Japan. The target age group selected was from 40 to 79 years. Based on the screening history, these were divided into two groups: prevalence screening and incidence screening. The prevalence screening group was defined as including persons who had no screening within 2 years and were screened initially. The incidence screening group was defined as including persons who were screened repeatedly by same method. It was assumed that the preclinical detectable phase was 1 year for interval cancer. Sensitivity was calculated by the detection method and by the incidence method. The expected numbers of cases were estimated based on the incidence of gastric cancer using the cancer registry. The observed numbers/expected numbers ratio (O/E) was also calculated in each group.
Results: The total number of persons in the target age group was 50,988, and they were divided into prevalence and incidence screening groups. Prevalence screenings included 7,388 for endoscopic screening and 5,410 for radiographic screening, while incidence screenings included 20,753 for endoscopic screening and 12,386 for radiographic screening. By the detection method, the sensitivity of prevalence screening was 0.955 for endoscopic screening and 0.893 for radiographic screening. By the incidence method, the sensitivity of prevalence screening was 0.886 for endoscopic screening and 0.831 for radiographic screening. By the detection method, the sensitivity of incidence screening was 0.977 for endoscopic screening and 0.885 for radiographic screening. By the incidence method, the sensitivity of incidence screening was 0.956 for endoscopic screening and 0.868 for radiographic screening. Although the sensitivity of endoscopic screening was always higher than that of radiographic screening,

they were not significantly different. The O/E ratio of prevalence screening was 2.435 for endoscopic screening and 1.408 for radiographic screening. The O/E ratio of incidence screening was 1.895 for endoscopic screening and 1.016 for radiographic screening. The O/E ratio was significantly higher for endoscopic screening than for radiographic screening.
Conclusion: Although the sensitivity of endoscopic screening was higher than that of radiographic screening, the O/E ratio suggested overdiagnosis.

Renewal of the National Cervical Screening Program

Hammond IG
University of Western Australia, Perth, Western Australia, Australia

Background: The National Cervical Screening Program (NCSP), for the past 20 years, has offered routine screening with Pap smears every 2 years for women between the ages of 18 and 70 years. Over this time, the incidence of cervical cancer and the mortality rate from cervical cancer have both decreased by approximately 50 percent. While the success of the NCSP cannot be disputed, the environment in which the program operates has changed. Since the introduction of the NCSP in 1991, there is a greater depth of knowledge and understanding about the natural progression of cervical abnormalities and the development of cervical cancer. Evidence about the screening age range and interval has also changed over time, and there are new tests for the early detection of pre-cancerous cervical changes. Furthermore, young Australian women are now provided the opportunity to be vaccinated against human papillomavirus (HPV), which prevents some HPV infections that can lead to cervical cancer. The aim of the Renewal is to ensure the success of the program continues and all Australian women, HPV-vaccinated and unvaccinated, have access to a cervical screening program that is based on current evidence and best practice. The Renewal will play a pivotal role in reviewing the science and technologies related to the NCSP to ensure its continuing success. The objectives of the Renewal are to: assess the evidence for screening tests and pathways, the screening interval, age range, and commencement for both vaccinated and non-vaccinated women; determine a cost-effective screening pathway and program model; investigate options for improved national data collection systems and registry functions to enable policy, planning, service delivery, and quality management; and assess the feasibility and acceptability of the renewed program for women.
Methods: The Renewal Steering Committee will guide the Renewal process, supported by the Australian Government's Department of Health and Ageing. It comprises cervical screening experts in the fields of gynaecological oncology, pathology, cytology, epidemiology, general practice, and nursing as well as Commonwealth and state and territory government representatives and a consumer advocate. The Committee will actively consult with and seek input from a wide range of NCSP partners, including health professionals, scientists, and consumers, through a Partner Reference Group. The first consultation with the Partner Reference Group was held in March 2012.

Engaging general practice in bowel screening

Holt L[1], Tremper S[2]
[1]Department of Health Victoria, Melbourne, Victoria, Australia; [2]General Practice Victoria, Melbourne, Victoria, Australia

Background: The aim of this project is to increase the awareness of general practitioners of bowel cancer screening and increase compliance with National Health and Medical Research Council (NHMRC) and Royal Australian College of General Practitioners (RACGP) Red Book bowel cancer screening guidelines, which recommend 2-yearly screening via faecal occult blood testing (FOBT) for all Australians aged 50 and over. Expected outcomes of this project is to decrease inappropriate referral for colonoscopy and to increase discussion about cancer screening and cancer risk factors between General Practitioners (GPs) and their patients. Evidence from Victorian Department of Health-funded research into bowel cancer screening knowledge and attitudes showed that GP endorsement is a key factor in men's and women's decisions to participate in bowel screening. A key concern with the current National Bowel Cancer Screening Program (NBCSP) design is the lack of engagement with

the primary care sector. This project provides the avenue for GPs and their patients to discuss bowel cancer testing, for GPs to encourage participation in the NBCSP for eligible patients, and to manage non-eligible patients as clinically appropriate in line with the NHMRC guidelines.
Methods: A clinical audit tool compatible with existing practice software was developed that enables auditing of the ordering of screening tests in general practices as well as system reminders (through Sidebar Prompt software) for bowel screening for eligible patients. The tool has also been designed to incorporate breast and cervical cancer screening audits and reminders.
Results: Twenty-two divisions of general practice covering 200 clinics are participating in the program across Victoria. This project is a collaborative project incorporating the Victorian Department of Health, with General Practice Victoria providing project management and division staff assisting practices with implementation of the software. Cancer Council Victoria is delivering GP education in collaboration with the Royal Australian College of General Practitioners to support the rollout of the program.
Conclusion: This project is significant to national cancer screening programs as the audit tool and prompt system will be available across the country to all practices using either Medical Director 3 or Best Practice medical software and receiving pathology results by electronic download. Baseline data has been collected and evaluation outcomes will be presented. The results of this project will be of interest to both international and national screening policy-makers.

Randomized trial of three methods of values clarification for decision making about PSA screening: A comparison of U.S. and Australian men

Howard K[1], Lewis C[2], Sheridan S[2], Crutchfield T[2], Hawley S[3], Brenner A[4], Pignone M[2]
[1]University of Sydney School of Public Health, New South Wales, Sydney, Australia; [2]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States; [3]University of Michigan, Ann Arbor, Michigan, United States; [4]University of Washington School of Public Health, Seattle, Washington, United States

Background: Patient preferences derived from values clarification may help inform design of screening programs, but how best to elicit values and preferences, and whether such preferences differ cross-nationally, has not been well examined. We compared, in a randomized controlled trial, three values clarification (VC) methods: balance sheet; rating and ranking; and a discrete choice experiment (DCE) for decision making about PSA screening in United States (U.S.) and Australian (AU) men.
Methods: Eligible participants were men ages 50–70 with no personal or family history of prostate cancer (PrCa) recruited from online panels of a survey research organization in each country. Participants were randomized to one of the three VC techniques and completed pre- and post-task questionnaires. Participants viewed information on four key attributes: chance of being diagnosed with PrCa, chance of dying from PrCa, chance of requiring a biopsy from screening, and chance of developing impotence or incontinence from screening. For the DCE group, we used a mixed logit model with effects coding to generate individual-level part-worth utilities and importance scores. Main outcomes were most important attribute, unlabeled screening test preference, and labeled screening intent, assessed on post-task questionnaires.
Results: We enrolled 911 participants (U.S.: 456; AU: 455), mean age was 59.7; 88.0 percent were white; 36.4 percent had completed a 4-year college degree; 42.0 percent reported a PSA test in the past 12 months. AU participants were more likely to be white and have recent screening. For the balance sheet group, 55 percent of U.S. and 76 percent of Australian respondents chose (labeled) PSA screening (OR 2.61; 95 percent CI 1.55, 4.37). In the ranking group, those ranking ability to reduce the risk of PrCa mortality as most important was similar by country: 52 percent (U.S.) and 54 percent (AU). DCE-derived attribute importance differed by country: 20 percent of U.S. men versus 51 percent of AU men had the chance of being diagnosed as most important; 73 percent of U.S. versus 28 percent of AU men had the chance of death as most important. After the tasks, unlabeled preference for the PSA-like option was greater for AU (39.1 percent) than U.S. (26.3 percent) participants (OR 1.76; 95 percent CI 1.33, 2.34). Labeled intent for screening was high for both countries: U.S.: 73.7 percent versus AU: 78.0 percent (p=0.308)

Conclusions: Preference for PSA testing was high when labeled but much lower when unlabeled. Australian men were more likely to prefer screening. For both countries, informed decision making rather than blanket policies for or against screening appear to be supported based on elicited values and preferences.

Comparative effectiveness of digital breast tomosysnthesis

Inge C, Armstrong K, Maidment A, Bristol-Demeter M, Schnall M, Conant EF
University of Pennsylvania, Philadelphia, Pennsylvania, United States

Background: Mammography represents the current standard for breast cancer screening. Although mammography has been demonstrated to reduce breast cancer specific mortality in multiple randomized trials, there is continued controversy related to its appropriate implementation for population screening. Much of this controversy is related to the performance of mammography with respect to false positive and false negative findings. The challenges related to mammography performance are in part related to the modest intrinsic soft tissue contrast of x-ray imaging, compounded by the fact that mammography is a projection technique that results in images of superimposed structures. The modest soft tissue contrast and superposition of structures makes the process of detecting cancer challenging. The difficulty related to interpreting mammograms result in a high false positive rate in order to achieve the high levels of sensitivity expected in the United States. It also results in variability in test performance across readers and centers. Digital breast tomosynthesis (DBT) is a technique that utilizes digital mammogram acquisitions acquired at different angular obliquities to reconstruct tomographic images of the breast. DBT removes much of the ambiguity related to superimposed structures. There have been several clinical trials of DBT which suggest this technique will have higher sensitivity and specificity than planar digital mammography (DM). Recently, the Hologic tomosynthesis system has been approved for clinical use by the United States Food and Drug Administration (FDA). This study aims to study the comparative effectives of DBT compared to DM in a routine screening environment.
Methods: The Hospital of the University of Pennsylvania has upgraded four of its six digital mammogram systems with an FDA-approved DBT capability creating a unique opportunity to assess the impact of DBT screening on patient outcomes and test performance, as well as identify the patient characteristics that influence the effectiveness of DBT compared to DM. Patients within the health system either undergo DBT or DM. The comparison cohort is the population screened with DM. Screening outcomes measured include callbacks, follow ups, ultrasound exams, biopsies, and cancer. Costs associated with the screening exam and downstream costs associated with the diagnostic work up will be measured in both cohorts.
Results: Stay tuned.
Conclusion: Given the lack of data related to the impact of DBT on breast cancer screening outcomes, this study will generate needed outcomes to inform the more widespread implementation of this new technology.

Employing functional DNA repair-based risk biomarkers to improve risk-benefit and cost-effectiveness of CT screening for the early detection of lung cancer

Livneh Z[1], Sevilya Z[1], Leitner-Dagan Y[1], Pinchev M[2], Kramer R[3], Elinger D[1], Rennert HS[2], Schechtman E[4], Freedman L[5], Rennert G[2], Paz-Elizur T[1]
[1]Weizmann Institute of Science, Rehovot, Israel; [2]Carmel Medical Center, Bruce Rappaport Faculty of Medicine, Technion-Israel Institute of Technology, Clalit Health Services National Cancer Control Center, Haifa, Israel; [3]Rambam Health Care Campus, Haifa, Israel; [4]Ben Gurion University of the Negev, Beer Sheva, Israel; [5]The Gertner Institute for Epidemiology and Health Policy Research, Chaim Sheba Medical Center, Tel Hashomer, Israel

Background: Lung cancer screening with helical CT was recently shown to effectively reduce lung cancer mortality. However, this screening modality has very high false-positive rates and raises concerns about technology cost and potential cumulative radiation risk. One strategy to minimize these difficulties, especially in low-resource settings, is to apply this screening approach only to smokers at very high risk. This strategy requires effective lung cancer risk biomarkers.

Methods: DNA repair is known to have a critical role in the etiology of cancers, due to its key function in eliminating DNA damage and preventing mutations. We therefore sought to develop cancer risk biomarkers based on DNA repair. Towards this goal we took a functional approach and developed functional DNA repair assays, highly reproducible and robust, that enable us to measure DNA repair levels in extracts from human peripheral blood mononuclear cells (PBMC). The first enzymatic activity assay that we have developed was for the repair enzyme 8-oxoguanine DNA glycosylase (OGG), which removes 8-oxoguanine from DNA (Paz-Elizur et al. 2007, *DNA Repair*, 6:45-60).
Results: Using this assay we found that reduced activity of OGG is a risk factor in lung (Paz-Elizur et al. 2003, *JNCI* 95:1312-1319) and head and neck cancer (Paz-Elizur et al. 2006, *Cancer Res.* 66:11683-11689; Paz-Elizur et al. 2008, *Cancer Lett.* 266:60-72).
Conclusion: Under the sponsorship of the Early Detection Research Network (EDRN) (National Cancer Institute, National Institutes of Health, United States), we have recently broadened this to a panel of three risk biomarkers, based on the DNA repair enzyme activities OGG1, N-methylpurine-DNA glycosylase (MPG) and human apurinic/apyrimidinic endonuclease (APE1) (OMA). The measurement of OMA DNA repair biomarkers is performed semi-automatically using a robotic platform, and its readout is fluorescence-based. It provides a personalized DNA repair score that was strongly associated with increased lung cancer risk in a population-based, blinded case-control study. Based on our recent results, using a cut-off that would include people at the lowest 5 percent of DNA repair score in the population, one may expect the group with a positive computed tomography (CT) finding and a positive DNA repair test to include 4- to 5-fold more individuals who have lung cancer than a group characterized only by positive CT. Planning is in progress for a cohort prospective study in conjunction with CT to validate this DNA repair panel. The combination of risk pre-screening followed by early detection by CT is expected to provide better risk-benefit and cost-effectiveness, which is particularly important in low-resource settings.

From guaiac to immunological fecal occult blood test: Performance characteristics and outcome results in a colorectal cancer screening program, Catalonia (Spain)

Milà N[1], Garcia M[1], Binefa G[1], Rodriguez-Moranta F[2,3], Moreno V[1,2,4]
[1]Catalan Institute of Oncology, Barcelona, Spain; [2]Bellvitge Biomedical Research Institute (IDIBELL) Colorectal Cancer Group, Barcelona, Spain; [3]University Hospital of Bellvitge, Barcelona, Spain; [4]University of Barcelona, Barcelona, Spain

Background: The aim of this project was to compare two screening strategies of fecal occult blood test (quantitative immunological test – fecal immunochemical testing (FIT) – versus biochemical test – guaiac fecal occult blood test (gFOBT)) in terms of validity for detection of advanced neoplasia and feasibility of use in a population-based screening program for colorectal cancer (CRC) in Catalonia.
Methods: First, we conducted a clinical study (2008–2009) with 335 subjects referred to colonoscopy due to symptoms, screening, or CRC family history. We asked them to perform both strategies of fecal occult blood test (collecting two stools from three bowel movements for gFOBT and one for FIT) before the colonoscopy. We analyzed diagnostic accuracy (positivity, sensitivity, specificity, positive and negative predictive value, and detection rates) from both strategies. The presence of fecal occult blood in five or six samples and two different hemoglobin thresholds (75 and 100ng/mL) were used to determine a positive FOBT result. A second study was conducted during the fourth round of the CRC screening program in Hospitalet de Llobregat (2008–2010). The gFOBT and FIT were offered to 50,227 and 12,707 individuals, respectively. We analyzed differences according to the screening strategy in acceptability, diagnostic results, and endoscopic resources (number of colonoscopies needed and time interval between the positive test and colonoscopy).
Results: The higher the hemoglobin threshold, the lower the positivity in FIT (ranging from 14.6 to 12.3). The lower positivity was in gFOBT (6.6 percent). Much higher sensitivity was reached with FIT (irrespective of the threshold considered) compared to gFOBT (from 40.0 percent to 51.1 percent versus 15.6 percent) at the expense of not much lower specificity. With similar cancer detection rate, the high-risk adenoma detection rate was more than six-fold higher in FIT than in gFOBT. Diagnostic accuracy in the CRC screening program was consistent with the results from the clinical study.

Participation was higher among individuals who used FIT (OR:1.35;CI95 percent:1.27-1.42) with similar dropouts and colonoscopy acceptance. The number of colonoscopies needed to detect cancer with the FIT was almost two-fold more than those needed with the gFOBT (13.6 versus 7.4).
Conclusions: Both studies pointed to the same direction: FIT is a good screening strategy. It is better than gFOBT to detect advanced neoplasia, especially with high-risk adenomas but it has also higher acceptance among the target population of the CRC screening program. Nevertheless, it is paramount ensuring enough resources to guarantee the quality of the CRC screening due to the large number of colonoscopies that would be required.

Integration of routine automated breast density assessment into organised breast cancer screening programs

Nickson C, Aitken Z
Centre for Women's Health, Gender, and Society, Melbourne School of Population Health, University of Melbourne, Carlton, Victoria, Australia

Background: High mammographic breast density is associated with breast cancer risk. In population mammographic screening programs, it is also associated with low program sensitivity, high interval cancer rates, and larger tumours at diagnosis. Routine measurement of breast density by population screening programs would immediately enable monitoring of screening performance according to breast density against changes in technologies and clinical practice. Routine measurement would also enable personalised screening according to breast density, for which optimal approaches are yet to be identified and depend in part on the resource setting. In any setting, monitoring or tailoring of screening according to breast density requires a well-validated breast density assessment that can feasibly be integrated into the population program. We evaluate the current technologies available for routine measurement of breast density in population screening programs. Then, using BreastScreen Victoria as a case study, we examine the resources and information required to translate those technologies into practice.
Methods: We review published methods for routine measurement of breast density from screening mammograms, including a critical review of how well each method has been validated against clinical outcomes such as breast cancer risk and the risk of an interval cancer. In consultation with BreastScreen Victoria staff we identify issues to be considered to enable incorporation of breast density measurement into the screening program.
Results: Methods for routine measurement of breast density from mammograms include visual assessment by radiologists, computer-assisted measurement by trained staff, and fully automated assessments that characterise image features such as the quantity of dense tissue, how scattered or solid the densities are, and the estimated volume of dense tissue. Methods have been developed and tested variously on analogue and digital mammogram datasets, with varying degrees of validation against clinical outcomes. Since the BreastScreen Victoria program utilises a wide variety of mammography machines, it would require breast density measurement suited to a wide array of image formats. To minimise disruption to the program and additional resource requirements, the method would need to be fully automated, standardised, reliable, fast, and developed to integrate smoothly into existing hardware and software infrastructure.
Conclusion: A number of methods are available for routine measurement of breast density from screening mammograms; however, some require further validation against clinical outcomes. Based on our case study of the BreastScreen Victoria program, integration of routine breast density measurement into organised breast cancer screening programs is possible but requires careful collaboration between researchers and program staff.

Implementation of cancer screening programmes: Standardizing the process

von Karsa L[1], Lignini T[1], Suonio E[1], Ducarroz S[1], Sigohko D, Anttila A[1,2]
[1]International Agency for Research on Cancer, Lyon, France; [2]Finnish Cancer Registry, Helsinki, Finland

In 2007 over 50 million screening tests were conducted in the European Union (EU) in publicly mandated programmes. The EU policy on cancer screening provides a comprehensive framework for evidence-based

decision-making at the governmental level and invites EU Member States to take common action to implement and improve breast, cervical, and colorectal cancer screening programmes with an organized, population-based approach and according to European quality assurance Guidelines.

Organized programmes are recommended because they include an administrative structure responsible for implementation, quality assurance, and evaluation. Population-based programmes aim to give each eligible individual an equal chance of benefiting from screening. They generally require a high degree of organization in order to identify and personally invite each individual in the eligible target population. The population-based approach to programme implementation is also recommended because it provides an organizational framework conducive to effective management and continuous improvement of the screening process, such as through linkage with population and cancer registries for optimization of invitation to screening and for evaluation of screening performance and impact.

The experience in Europe shows that the process of implementing and improving population-based cancer screening programmes across a country can be managed by: (1) coordinated planning, (2) feasibility testing and (3) piloting prior to (4) geographically phased rollout, and (5) quality-assured steady state. This enables the responsible authorities to control the pace of implementation. That, in turn, permits verification that requisite changes in current practice will effectively maximize the benefits and minimize the risks before substantial numbers of people are exposed to screening and before substantial resources are consumed.

Understanding the process of implementing and improving cancer screening programmes facilitates efforts to ensure that screening is performed in a manner which is acceptable to the population and achieves maximum, appropriate benefit with the least possible harm and expense. The European experience shows that several factors are crucial to the success of the implementation process: (1) autonomous programme management, (2) long-term political commitment and sustainable resources, (3) reliable and accessible cancer registration, (4) engagement of civil society, and (5) dedicated governance.

In most EU countries the translational phase up to completion of rollout has taken 10 years or more. The duration can be reduced through international exchange of experience and collaboration to avoid pitfalls encountered in other programmes and to mobilize external resources for training and coaching.

Lung cancer screening using low-dose multi-detector CT: The RCT in England. What is the potential role of primary care?

Weller D[1], Baldwin D[2], Hansell D[3], Duffy S[4], Brain K[5], Hands C[6], Patnick J[7], Campbell C[1], Field J[8]
[1]University of Edinburgh, Edinburgh, United Kingdom; [2]Nottingham University Hospitals, Nottingham, United Kingdom; [3]Royal Brompton Hospital, London, United Kingdom; [4]Wolfson Institute of Preventive Medicine, London, United Kingdom; [5]Cochrane Institute of Primary Care and Public Health, Cardiff University, Cardiff, United Kingdom; [6]Liverpool Cancer Research UK Centre, Cancer Research UK Liverpool Cancer Trials Unit, Liverpool, United Kingdom; [7]National Health Service Cancer Screening Programmes, Sheffield, United Kingdom; [8]The University of Liverpool Cancer Research Centre, Liverpool, United Kingdom

Background: In the United Kingdom, lung cancer outcomes are poor when compared with other developed countries. At present, the only evidence that lung cancer screening reduces mortality comes from the United States randomised control trial *National Lung Screening Trial.* However, before a screening programme can be recommended in the United Kingdom, it must be shown that similar mortality reductions can be achieved in a United Kingdom population and that this is a cost-effective intervention.
Methods: The United Kingdom Lung Cancer Screening Trial (UKLS) has been established at two principal sites. It recruits individuals identified on the electoral roll using questionnaires that assess risk of lung cancer based on the Liverpool Lung Project Risk Prediction Model. The questionnaire has been tested in the feasibility study for the trial and is now being utilised in the pilot UKLS trial. The pilot trial will randomise 4,000 people, and the full trial a further 28,000. An Implementation Group has been established with the explicit aim of identifying primary-care–based recruitment mechanisms which would have the potential to reduce inequalities in uptake in a future computed tomography (CT) screening programme. The primary end points of the UKLS study are lung cancer mortality, information on cost effectiveness of a national lung cancer screening programme, and descriptive information on uptake, acceptability, and the response of primary care to the trial.

Results: The study began recruiting in September 2011. The general practitioners in the two pilot recruitment regions are informed when their patients are approached through a letter from the Director of Public Health in their area. General practitioners are then informed if their patient is selected and consented into the pilot UKLS and provided with a copy of the lung function record and whether their patient is randomised into the CT arm of the pilot. If any abnormality is detected on the scan, they are sent a copy of the recruit's CT letter, with additional detailed information on the scan results.
This presentation will provide early results of recruitment efforts and discuss the implementation and uptake issues encountered to date with a focus on the role of primary care in the trial and more broadly in lung cancer screening.
Conclusion: Lung cancer screening using low-dose multi-detector CT has the potential to reduce mortality from lung cancer. The UKLS study will complement other international lung cancer screening trials and provide specific information on how primary care might be engaged to ensure an effective national lung cancer screening programme.

Improving participation in colorectal cancer screening: Evaluation of an Internet-delivered decision support tool

Zajac IT[1], Wilson C[2], Flight I[1], Turnbull D[3], Young G[2], Cole S[2]
[1]Commonwealth Scientific and Industrial Research Organisation (CSIRO), Adelaide, South Australia, Australia; [2]Flinders University, Adelaide, South Australia, Australia; [3]University of Adelaide, Adelaide, South Australia, Australia

Background: Colorectal cancer (CRC) is a major public health problem in Australia. It is the second leading cause of cancer-related death and the most frequently diagnosed internal cancer. Despite the significant impact of this disease, participation in screening using faecal occult blood test (FOBT) remains suboptimal. Therefore, this study explored the effectiveness of a Web-based Personalised Decision Support (PDS) tool at improving participation in CRC screening delivered as part of a public health screening program.
Methods: Three thousand four hundred and eight (3,408) participants were recruited into this randomised controlled trial (RCT) and assigned to one of three trial conditions: Tailored PDS; Non-Tailored PDS; or Control (paper-based). Participants were asked to visit the Web-based PDS tool to complete a questionnaire or complete a paper-based questionnaire in accordance with the condition they had been assigned to. Tailored PDS participants received feedback tailored to their responses to the questionnaire and screening decision stage. Those who visited the PDS tool or who returned a completed paper-based questionnaire subsequently received an invitation to screen via FOBT that was consistent with Australia's National Bowel Cancer Screening Program. This invitation was accompanied by either paper-based bowel cancer information (Control group only) or access to online information via the PDS.
Results: Analysis at the conclusion of the RCT revealed a statistically significant difference in participation between the three trial conditions [$\chi 2$ (2) = 14.93, $p<.001$]. FOBT participation rates were 78 percent, 84.8 percent, and 84.1 percent for Control, Non-tailored, and Tailored conditions, respectively.
Conclusion: Web-based Personalised Decision Support appears to have a positive impact on FOBT participation rates in an Australian setting. However, there appears to be no additional effect of tailoring the content of this online information based on the current results, because FOBT participation was essentially equal in the non-tailored Web condition. Tailoring is complex and costly and may not be necessary if the aim is simply to improve participation in a one-off screening invitation.

Pooled analysis of a self-sampling HPV DNA test as a cervical cancer primary screening method

Zhao F-H, Qiao Y-L
Cancer Institute, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, People's Republic of China

Background: Worldwide, one-seventh of cervical cancers occur in China, which lacks a national screening program. By evaluating the diagnostic accuracy of self-collected cervicovaginal specimens tested for human papillomavirus (HPV) DNA (self-HPV testing) in China, we sought to determine whether self-HPV testing may serve as a primary cervical cancer screening method in low-resource settings.
Methods: We compiled individual patient data from five population-based cervical cancer screening studies in China. Participants (n = 13,140) received self-HPV testing, physician-collected cervical specimens for HPV testing (physician-HPV testing), liquid-based cytology (LBC), and visual inspection with acetic acid (VIA). Screen-positive women underwent colposcopy and confirmatory biopsy. We analyzed the accuracies of pooled self-HPV testing, physician-HPV testing, VIA, and LBC to detect biopsy-confirmed cervical intraepithelial neoplasia grade 2 or more severe (CIN2+) and CIN3+. All statistical tests were two-sided.
Results: Of 13,004 women included in the analysis, 507 (3.9 percent) were diagnosed as CIN2+, 273 (2.1 percent) as CIN3+, and 37 (0.3 percent) with cervical cancer. Self-HPV testing had 86.2 percent sensitivity and 80.7 percent specificity for detecting CIN2+ and 86.1 percent sensitivity and 79.5 percent specificity for detecting CIN3+. VIA had statistically significantly lower sensitivity for detecting CIN2+ (50.3 percent) and CIN3+ (55.7 percent) and higher specificity for detecting CIN2+ (87.4 percent) and CIN3+ (86.9 percent) (all P values < .001) than self-HPV testing, LBC had lower sensitivity for detecting CIN2+ (80.7 percent, P = .015), similar sensitivity for detecting CIN3+ (89.0 percent, P = .341), and higher specificity for detecting CIN2+ (94.0 percent, P < .001) and CIN3+ (92.8 percent, P < .001) than self-HPV testing. Physician-HPV testing was more sensitive for detecting CIN2+ (97.0 percent) and CIN3+ (97.8 percent) but similarly specific for detecting CIN2+ (82.7 percent) and CIN3+ (81.3 percent) (all P values <.001) than self-HPV testing.
Conclusion: The sensitivity of self-HPV testing compared favorably with that of LBC and was superior to the sensitivity of VIA. Self-HPV testing may complement current screening programs by increasing population coverage in settings that do not have easy access to comprehensive cytology-based screening.

Incorporating Cancer Prevention Strategies Into Organized Screening Programs

The STI.VI. biobank: Biological sample collection within a study testing the cancer screening setting as a 'teachable moment' for lifestyles changes

Anatrone C[1], Giordano L[1], Martinasso G[1], Vineis P[2], Matullo G[3], Giubilato P[1], Segnan N[1], and STI.VI. Working Group
[1]Reference Center for Epidemiology and Prevention of Cancer (CPO) and University Hospital San Giovanni Battista in Torino, Torino, Italy; [2]Imperial College London, London, United Kingdom; [3]University of Torino, Torino, Italy

Background: The importance of biomarkers and epigenetic, metabolic and metabonomic profiles in the aetiology of disease, including cancer development and progression, is increasingly being recognized. The **creation of a biobank** within the STI.VI. trial **allows:**

- To collect biospecimens in order to perform metabolic, metabonomic, and epigenetic tests in participants.
- To match biological samples with extensive individual information such as dietary and lifestyle habits and to monitor the modifications of potential biomarkers as lifestyle changing.
- To follow up eligible subjects periodically concurrently with the screening invitations.
- To define and follow standardised methodology for optimal biospecimen collection, processing, storage, retrieval, and dissemination.

Methods: Women aged from 50 to 54 years involved in breast cancer screening and 58-year-old males and females undergoing colorectal cancer screening are invited to participate in the study. **Compliers are randomized (ratio 1:1:1:1) into four groups: Diet, Physical Activity, Physical Activity and Diet, and "Usual Care" controls (see** the STIVI abstract for more details). **During the recruitment phase 14 ml of blood and about 3 ml of saliva are collected for all the groups. Two types of blood samples are drawn: one for immediate biochemical analysis and another to be frozen. The fresh blood is used for instantaneous examinations for the following clinic-biochemical parameters: Insulin, Glucose, Total Cholesterol, LDL, HDL, Triglycerides, Minerals (Sodium, Potassium, Calcium, Iron), IGF-I, Testosterone, 17-ß-Estradiol, SHBG. These analyses are made for women invited to mammography screening, while for people invited to colorectal screening supplemental tests are made also for vitamin D, 25 OH, PRC, and high sensitive PRC. The remaining blood is sent, at room temperature, to the laboratory to be stored. Samples are aliquoted by robotic liquid handler in appropriate micro-tubes with a bi-dimensional code, uniquely associated to the screening identification code. All tubes (whole blood**, plasma, serum, **buffy coat**, **red blood cells) are stored in a -80°C freezer equipped with a security system and with software for safe samples storage and traceability. Saliva are collected and cryopreserved with the same modalities as blood samples.**
Until now, we collected bio-specimens of 982 participants, of which 251 have already undergone a follow up fasting venipuncture after 14 months.
Conclusion: In the next future, we **will test**, **evaluate, and compare metabolic, epigenetic,** and **metabonomic differences in** collected bio-specimens**, in order to assess** the impact of environmental exposure and lifestyle changes on diseases occurrences.

How Cancer Council Victoria combines primary and secondary prevention programs to address cancer of the cervix

Broun K, O'Donnell H, Mullins R
Cancer Council Victoria, Melbourne, Victoria, Australia

Since 1991, Cancer Council Victoria (CCV) has developed and implemented the Communications and Recruitment Program for PapScreen Victoria, as part of the National Cervical Screening Program to prevent cancer of the cervix.
The program aims to increase the proportion of women screening every 2 years, as per Australian guidelines.

In 2007, the Australian government added the human papillomavirus (HPV) vaccine to the National Immunisation Program (NIP) offering routine HPV vaccine free of charge to schoolgirls aged 12–13 years. A 2-year catch-up program was also offered to females aged 14–26 years.

This NIP addition caused a sudden surge in the public's awareness and interest in HPV. There was an immediate need for PapScreen to inform women about HPV and reinforce the importance of continued screening in this new era of HPV immunisation. Key messages were developed, resources adapted, and public relation activities undertaken to embed this new information. Additionally, CCV lent a voice in support of HPV immunisation and has undertaken various strategies over subsequent years to communicate the benefits of the vaccine, including developing a new website www.cervicalcancervaccine.org.au.

Uptake of the HPV vaccine in Victoria has been good with 73 percent of schoolgirls aged 12–13 years having the three-dose vaccine. However, coverage rates at a local government area (LGA) level vary considerably across metropolitan and rural regions, with 27 percent of LGAs having less than 70 percent coverage. This disparity was concerning to CCV, and after successfully advocating the state government, CCV was funded to undertake a project to address low HPV immunisation coverage rates.

A key component of the project was a survey of local government immunisation providers to better understand school-based immunisation delivery methods and constraints. With a 93.5 percent response rate, the survey provides current data on the barriers and limitations impacting upon successful HPV immunisation in Victoria. CCV is working with six LGAs to pilot strategies to improve HPV immunisation uptake.

CCV now has a comprehensive cervical cancer prevention strategy, with both primary and secondary prevention programs working collaboratively. Many opportunities have arisen whereby the messages of immunisation and screening have been interwoven successfully. Recent Victorian research has shown that the school-based HPV immunisation program may result in more equitable cervical cancer prevention than screening. CCV is well placed to capitalise on these findings and effectively influence cervical cancer prevention activities.

Transition from mammogram-specific reminders to annual birthday letters for breast cancer prevention

Buist DSM, Bowles EJA, Gao H, Brandzel S, Romaire MA, Anderson ML, Rutter C
Group Health Research Institute, Seattle, Washington, United States

Background: Reminder letters are effective at prompting women to schedule screening mammograms. Group Health Cooperative (GHC), an integrated health care delivery system in the United States, has provided risk-based, tailored reminder letters to women for screening mammography since 1985. As part our effort to improve preventive care delivery, mammogram-specific reminder letters were phased out in 2007 and replaced with a single annual, personalized letter sent on a member's birthday. The "birthday" letter includes multiple upcoming recommended preventive care services, including mammography, and corresponding due dates. The effectiveness of this multiple preventive services reminder letter is unknown. This study aimed to compare the effectiveness of the mammogram-specific reminder letter (sent just before a woman was due for a mammogram) to the birthday letter (which addresses multiple preventive services and is not timed around service due dates) on mammography receipt. We also explored the number of prevention recommendations in the birthday letter and time between birthday letter and due date on breast cancer screening adherence.
Methods: We studied 117,259 women aged 40 to 74 years enrolled in GHC. From 2005–2011, these women were mailed 116,782 mammogram-specific and 166,832 birthday letters. The letter was our unit of analysis; each letter was considered a separate observation and screening receipt (defined as receiving a screening mammogram ≤6 months). We modeled the odds of obtaining a screening mammogram after receiving the birthday letter relative to the mammogram-specific letter, using logistic regression with generalized estimating equations to account for correlation between repeated observations within women. We controlled for demographic and health care use characteristics and stratified by whether women were up-to-date or overdue for screening at the mailing.
Results: Fifty-two percent of mammogram-specific letters and 41 percent of birthday letters were followed by a screening mammogram ≤6 months. Adherence varied little with increasing number of recommended preventive services—40 percent with 1–2, 43 percent with 3, and 37 percent with 4–8 recommendations. Among up-to-date women, birthday letters resulted in significantly less mammography receipt compared to mammogram-specific

(odds ratio=0.47; 95 percentCI:0.46-0.48). Birthday letters were also negatively associated with mammography receipt compared to mammogram-specific letters among women overdue (odds ratio=0.80; 95 percentCI:0.78-0.82).
Conclusion: Preliminary analyses suggest birthday letters are less effective than mammogram-specific reminder letters at prompting women to undergo breast cancer screening. Birthday letters had a stronger negative effect on adherence among up-to-date women with screening versus overdue women. Future analyses will examine the effect of time between letter receipt and screening due date.

Prevention and early detection of breast cancer: The Brazilian experience in the production of health information and communication materials

de Assis M, Bortolon PC, Claro IB, Ribeiro C, Tomazelli JG, da Silva RC, dos Santos AMR, Vieira MF
Instituto Nacional de Câncer José Alencar Gomes da Silva, Rio de Janeiro, Brazil

Background: The Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA), a branch of Brazil's Ministry of Health, coordinates actions for national cancer control in partnership with health departments of the states and municipalities. INCA's early detection division has been developing information and communication tools consistent with integrality of health care, contemplating primary prevention of breast cancer in conformity with the national policy for health promotion.
This report aims to present INCA's current experience in the production of health information and communication materials on prevention and early detection of breast cancer.
Results: Since 2009, several informative materials were produced for breast cancer control: the program's Website; update of brochure for the general public *(Information Can Save Lives);* brochure with recommendations for reducing the mortality from breast cancer; and posters about prevention, screening, and early diagnostic. During the development of the communication materials, some methodological questions were considered, such as the concern for a clear and attractive language to the population; the choice of images that arise interest and are consistent with the information presented; and the purpose of avoiding the prescriptive and normative tone of the technical recommendations to ensure the right to correct information and enhance women's autonomy. Those materials have been published both in electronic and printed versions and have been distributed to health departments and institutions that carry out preventive actions, seeking to disseminate basic information and subsidize the production of other communication materials by different segments of society in a convergent way with INCA's technical recommendations.
Conclusion: Since those materials have been a reference on prevention and early detection of breast cancer, it is necessary to structure the production team for continuous qualification on the health communication actions. A strategy for production and reproduction of these communication materials must be established to stimulate the local level elaboration, covering cultural issues of each region. The perspective is to systematize research on how the messages are received and to develop communication strategies on social networks.

STI.VI. pilot RCT on lifestyles impact on health outcomes in participants in breast and colorectal cancer screening: Preliminary results

Giordano L, Gallo F, Menardi A, Anatrone C, Senore C, Segnan N, and the STI.VI. Working Group
Reference Center for Epidemiology and Prevention of Cancer (CPO) Piemonte and University Hospital San Giovanni Battista in Torino, Torino, Italy

Introduction: Overweight and sedentariness are associated to an increased risk of cancer. Promoting healthy lifestyles can enhance people's attitudes to adopt health-oriented behaviours and consequently to decrease their cancer risk. A cancer screening programme can be an ideal setting to introduce such advices.
Methods: Women aged 50–54 years involved in breast cancer screening and 58-year-old males and females undergoing colorectal cancer screening are invited to participate in the study. Compliers are randomised (ratio 1:1:1:1) into four groups: diet, physical activity, physical activity and diet, and usual care control. All subjects

undergo biological sampling (blood and saliva) and anthropometric measurements and fill out a self-administered questionnaire on their dietary habits and physical activity. All subjects enrolled receive a booklet with basic information about diet and physical activity. Subjects randomized to the three intervention groups are also offered one theoretical and three training courses specifically designed for the different interventions proposed and aimed at reinforcing the educational counseling and at supporting behavioural changes. All measurements are repeated at 8 (but blood sampling) and 14 months.
Results: At February 2012 a total of 771 people (673 women, 98 men) have been enrolled in the study and 558 have completed the planned intervention protocol. A high proportion of participants (78 percent) shows a high educational level, 54 percent report a sedentary job, 16 percent currently smoke (11 percent women, 16 percent men); 49.7 percent are overweight or obese (45.5 percent in women, 78.6 percent in men) and 20 percent present a metabolic syndrome; 36.5 percent declare they regularly practice physical activity (49.1 percent in the normal weight group and 27.2 percent and 17.7 percent in the overweight and obese group). People rating their health as good/excellent are 61.2 percent, and only 6.4 percent consider having incorrect dietary habits. More than 90 percent of participants report a lower-than-recommended legume intake, while 51 percent women and 61 percent men report an higher daily meat consumption. Blood samples assessments and comparisons between baseline and follow-up questionnaires are in progress.
Conclusion: These preliminary findings allow characterising subjects willing to participate in lifestyle interventions. Notwithstanding the self selection of participants, these interventions can be effective both in correcting behaviours erroneously considered adequate but not consistent with the international scientific recommendations and in increasing the positive attitude to introduce behavioural changes. The implementation of a bio bank will allow studying the role of various biomarkers or epigenetic mechanisms in explaining the impact of environmental exposure and lifestyle changes on diseases occurrences.

Cancer screening in Georgia

Gvamichava R
The National Screening Center, Tbilisi, Georgia

Background: According to the modern international practice, the mass screening is the most efficient way of the breast cancer prevention. This method is common in many countries of the world. By implementing the screening programmes and revilement of pathology at the early stage, developed countries have managed to significantly reduce the death rate of the breast cancer. The National Screening Center (NSC) of Georgia was established in 2008 by the Municipality of Tbilisi to execute breast and cervical cancer screening programme under the patronage of the First Lady. The programme is implemented by the NSC with the co-funding from Tbilisi Municipality, United Nations Population Fund (UNFPA), and the Ministry of Health. It is free of charge and intended for woman of particular age group: 40–70 for the breast screening and 25–60 for cervical screening.
Methods: This innovative project is one of the first of its kind in the Eastern Europe and Central Asia that aims to increase the detection of reproductive system cancers at early stages in order to reduce the mortality of women caused by these diseases. The programme is determined to achieve these results through ensuring equitable access for the women of the target ages to the breast and cervical cancer screening services and at the same time to maintain high standards of the programme, service delivery, monitoring, and accountability. The NSC carries out the following investigations for females willing to undergo screening: for breast cancer – physical exam, radiography exam based on BIRAD system, and ultrasound and cytology investigations; for cervical cancer – PAP smear, colposcopy investigation, and punch biopsy along with morphology investigation.
Results: During 2008–2011, a total of 88,399 females were screened for the breast cancer and 98,944 for the cervical cancer. In addition under the new activities of the NSC during 2010–2011 period, 6,201 men were screened for prostate cancer, and during 2011 a total of 2,461 patients were screened for colon cancer. The achievements of the program made the Federal government of Georgia decide to replicate this project at the National level: in 2009 the cancer screening programme has been launched in all regions of Georgia under the management of the NSC. Success of this program was proved by the increase of breast cancer percentage index diagnosed at early stage compared to previous years. For instance, in 2008, 32 percent of women were diagnosed with the I and II stage breast cancer while this figure reached 83 percent in 2011.

Health IT-based breast cancer risk assessment in primary care

Haas JS[1], Colditz GA[2], Murray M[1], Schneider LI[1], Bates DW[1], Giovanni M[1], Baer HJ[1]
[1]Brigham and Women's Hospital, Boston, Massachusetts, United States; [2]Washington University in St. Louis, St. Louis, Missouri, United States

Background: In the United States, breast cancer risk assessment and screening is conducted primarily through health care organizations by primary care providers, rather than through national screening programs. This offers the potential for more integrated care, but introduces challenges in systematic implementation as primary care providers face many competing demands during office visits. This study aimed to evaluate whether a variety of health information technology (IT) tools can be used to collect patient-reported family health history and behavioral risk factor data and integrated with an electronic health record (EHR). Outcomes included the documentation of risk factors, data validity (compared to family health history obtained by a genetic counselor), and patient-reported discussion of screening.
Methods: During 2010–2011 we conducted two pilot practice-based controlled trials. Both enrolled adults ages 18–75 with an upcoming primary care visit. One trial (n = 842) tested 3 different data collection methods (secure internet portal at home, waiting room "kiosk", automated phone call) versus usual care. The other trial (n = 996) tested completion of a brief risk assessment on a waiting room kiosk with presentation of a personalized risk report to the patient versus usual care.
Results: In both trials, use of health IT tools led to modest improvements in EHR-documented family health history compared to the control groups. Level of documentation did not vary by the type of data entry portal. Few (less than 5 percent) of conditions reported by patients were found to be inaccurate by the genetic counselor, but some under-documentation was observed for family health history compared to the counselor. Among intervention women who completed the risk assessment, 9.1 percent were at above-average risk for breast cancer. Participation was not associated with improvement in patient-doctor discussion of family history, lifestyle factors, or screening.
Conclusion: Health IT can be used to improve the documentation of family health history. Further research is needed to determine how risk appraisal tools can be integrated with workflow and how they affect risk assessment, provider decisions on the use of screening, and changes in the health behaviors of patients.

Genetic counseling and prophylactic oophorectomy rates following a guideline change recommending systematic referral to genetic counseling for women at high risk of breast and ovarian cancers

Pocobelli G[1,2], Chubak J[1], Hanson N[1], Drescher C[3], Resta R[4], Urban N[3], Buist DSM[1]
[1]Group Health Research Institute, Seattle, Washington, United States; [2]University of Washington, Seattle, Washington, United States; [3]Fred Hutchinson Cancer Research Center, Seattle, Washington, United States; [4]Swedish Medical Center, Seattle, Washington, United States

Background: We sought to determine whether genetic counseling and prophylactic oophorectomy rates changed after the introduction of a 2007 health plan clinical guideline recommending systematic referral to a genetic counselor for women with a personal or family history suggestive of an inherited susceptibility to breast and/or ovarian cancer.
Methods: We conducted a retrospective cohort study of 18,390 female members of Group Health, an integrated health care delivery system in the United States. We included women aged 35 years or older during 2004–2009 who reported a personal or family history (collected on a questionnaire completed at any mammogram) consistent with an inherited susceptibility to breast and/or ovarian cancer. We ascertained oophorectomies from automated claims data and determined whether surgeries were prophylactic by medical chart review. Rates were age-adjusted.

Results: Genetic counseling rates increased from 5.1/1,000 person-years (95 percent CI: 4.3-5.8/1,000) before (January 2004–March 2007) to 10.2/1,000 person-years (95 percent CI: 9.0-11.4/1,000) after (April 2007–Sept 2009) the guideline change. Prophylactic oophorectomy rates were similar before, 0.8/1,000 person-years (95 percent CI: 0.5-1.1/1,000), and after the guideline change, 1.0/1,000 person-years (95 percent CI: 0.6-1.3/1,000), whereas bilateral oophorectomy rates for other indications decreased. Bilateral oophorectomy rates were greater in women who saw a genetic counselor, 38.2/1,000 person-years (95 percent CI: 25.7-50.7/1,000), compared to women who did not, 2.8/1,000 person-years (95 percent CI: 2.4-3.2/1,000). Among women who saw a counselor, bilateral oophorectomy rates were greater in those who had genetic testing compared to those who did not, 44.9 versus 29.0/1,000 person-years. Among women who had counseling and testing, bilateral oophorectomy rates were appreciably greater following a positive genetic test result for breast/ovarian cancer risk, 387.8/1,000 person-years, compared to a non-positive genetic test result, 25.1/1,000 person-years.
Conclusion: A guideline change recommending systematic referral of high-risk women to genetic counseling was associated with increased genetic counseling rates. Prophylactic oophorectomy rates were unchanged; however, bilateral oophorectomy rates for other surgical indications decreased. Among women who received genetic counseling, our finding that bilateral oophorectomy rates were greater among those who had genetic testing compared to those who did not (appreciably greater in those who had a positive genetic test) is consistent with the idea that genetic counseling leads to finer risk stratification and higher-risk women are more likely to have their ovaries removed.

Screening Participation Rates

Breast cancer screening for immigrant and underprivileged women at the Ormylia Foundation, Center for Disease Prevention, Panagia Philanthropini in Northern Greece

Anthony CS[1], Empkie T[2], Gramling R[3], Boumpas DT[4], Chryssogonidis I[5], Charizanos DK[1], Piralis PG[1], Sikiotis S[1], Baracahnou D[1]
[1]Ormylia Foundation, Panagia Philanthropini, Chalkidike, Greece; [2]Brown University, Providence, Rhode Island, United States; [3]University of Rochester, Rochester, New York, United States; [4]University of Crete, Heraklion, Crete, Greece; [5]Aristotle University of Thessaloniki, Thessaloniki, Greece

Background: Ormylia implements high-quality standardized breast cancer screening in Northern Greece. Communities in the region are isolated geographically, economically, culturally, and socially. Groups include Muslim religious minorities and immigrants from Africa, Eastern Europe, and Asia. Ormylia has been successful in engendering trust and mobilizing women to participate in breast cancer screening. Northern Greece has small rural mountainous and seaside villages with often-impoverished communities. Populations include Muslim religious minorities (Turkish-speaking, Pomaks, and Roma) together with immigrants from Eastern Europe, the Middle East, and Africa. The national health system is out of reach for most of these people. The majority of women from these groups are not familiar with the need for breast care. Inadequate funding combined with language and cultural differences have created a severe lack of understanding regarding the lifesaving importance of breast cancer screening. Insufficient personal resources, cultural taboos, fear, and mistrust are barriers for women seeking care.
Methods: A dialogue with community matriarchs, educators, leaders, Muslim and Christian clergy, and advocates was cultivated. Fliers translated into the local vernacular were distributed to women by volunteers, in houses of worship, and to school children who took fliers home to their mothers and grandmothers. Women then organized into groups of 30–50 for screening by appointment. For Muslims only female practitioners were staffed. A translator was provided. Women received a free clinical breast exam and mammogram. During screening women received literature in their language and participated in a seminar related to detection and treatment. Women were instructed by their practitioner during their clinical breast examination in the correct method of doing breast self examination. Those in need of further diagnosis or treatment were referred within 5 working days to respective centers. Detected breast cancers were treated within 2 weeks.
Results: 843 Muslim and immigrant women were screened in 2010–2011. Hundreds wait to be screened according the fiscal resources available. By providing a friendly atmosphere combined with high-quality standardized mammography, Ormylia has become a hub for these populations' care.
Conclusion: The positive outcome of engaging community decision makers from diverse backgrounds as advocates demonstrates that when a broad social base of support is developed with sincerity and combined with warm and respectful standardized medical care, hard-to-reach, underprivileged women can be successfully recruited for breast cancer screening. Predicated on similar modalities of outreach and standardized screening, it is therefore feasible to duplicate these results in other similar communities.
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Compliance by invitation round and community in the Stockholm Screening Program

Blom J[1], Lundström V[2], Kilpeläinen S[2], Törnberg S[2]
[1]Karolinska Institutet, Stockholm, Sweden; [2]Regional Cancer Centre, Karolinska University Hospital, Stockholm, Sweden

Background: In 2008, screening for colorectal cancer with fecal occult blood test (FOBT) of people born in 1942 and 1946 (i.e., 66 and 64 years old, respectively) was introduced in the county of Stockholm, Sweden, and the

same cohort was re-invited for a second screening round in 2010. We aimed to investigate participation by screening round, and, if there were any differences between communities.
Methods: Information on immigration was retrieved from Statistics Sweden. Compliance by screening round, gender, and community was analyzed with Chi2 test, and results were considered statistically significant at $p<0.05$.
Results: In total 42,500 people were invited in both screening rounds, with higher participation rate second round (64.0 percent versus 65.2 percent [$p<0.01$]). In first and second round, there were more women than men participating (68.5 percent versus 59.3 percent and 69.6 percent versus 60.5 percent [$p<0.01$, both rounds]). In both rounds, there were statistically significant differences between communities with lowest and highest participation rate (61.3 percent versus 70.9 percent and 62.6 percent versus 71.5 percent), but also between communities with lowest and highest proportion participating women (64.3 percent versus 75.2 percent and 65.0 percent versus 75.3 percent first and second round, respectively) and men (56.3 percent versus 66.8 percent and 57.0 percent versus 68.0 percent first and second round, respectively), and between urban Stockholm and the country-side community of Norrtälje (61.4 percent versus 66.9 percent and 62.8 percent versus 67.4 percent first and second round, respectively). Although, there was no difference in compliance between the community with highest and lowest proportion of immigrants (Botkyrka [41 percent immigrants] versus Vaxholm [9 percent immigrants]) (first round $p=0.19$, second round $p=0.11$). The first-round statistically significant difference between communities in participation after reminder (lowest 9.5 percent, highest 13.8 percent) and total number of default tests (lowest 5.3 percent, highest 12.0 percent) persisted in the second round of screening. There were no statistical differences between the communities regarding number of positive tests or follow-up colonoscopies at either round.
Conclusions: In a regional FOBT-screening program with a relatively high first-round compliance, the total participation rate second round was maintained. There are persistent significant differences in compliance between gender and communities. The community belonging may reflect socio-economic status or health care availability, but the individual decision to obey invitation is unclear and needs further investigation. Nevertheless, compliance is an important measure of program quality and needs continuous evaluation.

Disparities in cancer, diabetes, and cholesterol screening in Ontario, Canada: A population-based study using area-based methods

Borkhoff CM, Saskin R, Liu Y, Tinmouth J, Baxter N, Rabeneck L, Paszat LF
Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

Background: Most new cases of cancer occur among those who have never been screened or are under-screened. Area-based methods are useful in studying disparities in health care, as services can be tracked over time and geographic location. We examined routine screening for colorectal, cervical, and breast cancer, as well as diabetes and cholesterol, and whether these rates differ by neighbourhood-level sociodemographic factors.
Methods: We conducted a population-based retrospective cohort study to examine rates of screening in 2009 among all residents of Ontario, Canada (N=12,160,282), living in 19,177 dissemination areas (DAs) identified as screening-eligible by means of linked administrative databases. Receipt of cancer screening (colorectal - women and men, 50–74 years, fecal occult blood test past 2 years or endoscopy past 5 years; cervical - women, 30–69 years, Pap test past 3 years; breast - women, 50–74 years, mammogram past 2 years), diabetes (women and men, 50–74 years, blood glucose past 2 years), and cholesterol (women and men, 50–74 years, blood cholesterol past 2 years) screening was determined using fee and laboratory codes in Ontario physician service claims. Using postal codes, each person was assigned to a DA or neighbourhood. Data from the 2006 Canadian census was used to determine sociodemographic characteristics for each DA. DAs were grouped into quintiles or categories based on the sociodemographic variables, and disparity (least / most advantaged) rate ratios were calculated.
Results: Colorectal cancer screening (women - 51 percent; men - 45 percent) showed the lowest participation, and diabetes (women - 70 percent; men - 62 percent) and cholesterol (women - 68 percent; men - 63 percent) screening had the highest participation. Low income, recent immigration, Aboriginal identity, foreign language, and visible minority were all associated with lower screening rates, though disparities were not as great for glucose and cholesterol screening as for cancer screening. Colorectal cancer screening rates were lowest in neighbourhoods with more than 33 percent Aboriginals (women - 33 percent; RR 0.64; 95 percent CI 0.58-0.71 and men -

26 percent; RR 0.58; 95 percent CI 0.51-0.64). Screening rates were particularly low in DAs with low income and high immigration for all cancer screening: *colorectal* – women - 38 percent; RR 0.73; 95 percent CI 0.72-0.75 and men - 30 percent; RR 0.65; 95 percent CI 0.63-0.67; *cervical* – 45 percent; RR 0.73; 95 percent CI 0.72-0.74 and *breast* – 44 percent; RR 0.72; 95 percent CI 0.70-0.73.
Conclusion: Knowing which DAs have the lowest rates and what sociodemographic factors are related to low rates can inform the development of targeted neighbourhood interventions to reduce disparities in cancer screening. Increased cancer screening may be achieved by an integrated chronic disease screening program leveraging the higher diabetes and cholesterol screening rates.

Which U.S. smokers will comply with recommendations for lung cancer screening with low-radiation-dose helical ct? Best guesses using data from the National Lung Screening Trial (NLST)

Brewer B[1], Payte N[1], Marcus P[2]
[1]Westat, Rockville, Maryland, United States; [2]National Cancer Institute, Bethesda, Maryland, United States

Background: The National Lung Screening Trial (NLST) demonstrated a 20-percent reduction in lung cancer mortality with low-dose helical CT (LDCT) screening for heavy and/or long-term smokers. If this finding leads to recommendations for mass screening, community-based screening programs will need to know who is likely to comply in order to maximize limited financial and staffing resources as well as community participation.
Methods: Data from the Lung Screening Study (LSS) component of the NLST were examined to investigate possible demographic predictors of compliance. The LSS recruited 34,614 participants in total; 17,309 were randomized to receive three annual LDCT exams.
Results: Overall, LSS participants were highly compliant with LDCT screening exams (95 percent), but compliance among those eligible to receive a screen was higher at the first round than at the later two rounds (first: 98 percent; second: 94 percent; third: 93 percent). At the last screening round, compliance varied by screening center location; lowest compliance (88 percent) was observed for the LSS site in Hawaii, and highest compliance at the site in Colorado (96 percent). Compliance at that round was similar for the two genders and age at recruitment. When race was examined, compliance at the last round was higher among Whites (94 percent) than Asians (91 percent) and African Americans (87 percent). Our poster also will report on the relationship of compliance and other factors, including smoking history.
Conclusion: Throughout the course of NLST, screening center staff often discussed techniques to improve compliance. Successful techniques that may be of use in community-based settings included frequent outreach to participants (including reminders) and small incentives after their exams, such as refrigerator magnets and calendars. The screening centers with the highest compliance had a very good understanding of the regional characteristics of their population and continually tailored compliance efforts to keep participants engaged. Additionally, these centers placed a great emphasis on participant involvement with the program. We will explore these strategies in more detail in our poster.

Comparing uptake of fecal occult blood tests for colorectal cancer screening: Results from a randomized controlled trial

Chubak J[1,2], Bogart A[1], Laing S[2], Green B[1]
[1]Group Health Research Institute, Seattle, Washington, United States; [2]University of Washington, Seattle, Washington, United States

Background: The goal of the study was to compare the uptake of three fecal occult blood tests (FOBTs) for colorectal cancer (CRC) screening: a 3-sample guaiac FOBT and two different fecal immunochemical tests (FIT).
Methods: We invited 10,359 members of an integrated healthcare delivery system aged 50–74 and due for CRC screening to participate in a randomized controlled trial (RCT) of CRC screening. After consenting and completing a baseline survey, eligible participants (N=2,237) were randomized to receive one of three mailed FOBTs: a 3-stool

guaiac-SENSA test (Hemoccult) requiring dietary restrictions, a 1-stool FIT (OC-MICRO®), or a 2-stool (InSure®) FIT. Neither of the FIT tests required dietary alterations. Participants were classified as adherent if they returned any FOBT within 6 months of the date the study cards were mailed to them. We conducted an intent-to-treat analysis, comparing uptake in the first 6 months across groups using Kaplan Meier estimates of the proportion screened, with inference based on the log-rank test across the three randomized groups. In a post-hoc analysis, we performed pair-wise comparisons of the three arms using log-rank tests with a Bonferroni correction to account for multiple comparisons.
Results: The mean age of participants was 58 years, the majority was female (58 percent), and 18 percent were non-White. Participant characteristics, including attitudes toward CRC screening, education, employment status, and family history of colorectal cancer were balanced across the randomization groups. By 6 months after tests were mailed, FOBT uptake was: 70 percent (95 percent confidence interval [CI] 66 percent-73 percent) in the 1-stool FIT arm, 65 percent (95 percent CI: 61 percent-68 percent) in the 2-stool FIT arm, and 62 percent (95 percent CI: 59 percent to 69 percent) in the 3-stool gFOBT arm (log-rank p-value for any difference <0.0001). Post-hoc pair-wise comparisons showed that uptake in the 1-stool FIT arm was significantly higher than in either of the other two arms.
Conclusion: Completion of FOBTs was highest among persons mailed the 1-stool OC-MICRO® FIT compared to the 2-stool InSure FIT test or the 3-sample guaiac-SENSA gFOBT test. Differences in uptake are likely attributable to the number of samples required, but may also be influenced by the required stool sampling methods or dietary restrictions.

Defining and calculating measures of screening participation for international comparative effectiveness research

Chubak J, Kamineni A, Wernli K, Rutter C
Group Health Research Institute, Seattle, Washington, United States

Background: Measuring participation in cancer screening programs is critical for understanding and improving program effectiveness. Comparison of different programs and policies requires establishment and use of common definitions of screening participation. Reported measures of participation can differ in several important ways, including: 1) whether they are based on counts of persons or person-time; 2) how people diagnosed with cancer are handled; and 3) how people who are lost to followup or otherwise censored are handled. Person-level participation measures focus on identifying people in need of screening. Person-time participation measures focus on the time spent in and out of compliance with screening measures and are useful for explaining benefits and failures of screening programs. We describe person-level and person-time measures of screening participation for prospective and retrospective studies.
Methods: Using a hypothetical example of fecal occult blood testing (FOBT) for colorectal cancer detection, we compared results based on different participation measures for prospective and retrospective study designs. In the "base case" hypothetical example presented, 0.1 percent of the population has colorectal cancer and 60 percent of the population is screened during the 2-year follow-up. We initially assumed no association between screening participation, underlying colorectal cancer risk, and loss to follow-up. We explored the effect of changing the underlying cancer prevalence, screening prevalence, and proportion lost to follow-up. We also examined scenarios when loss to follow-up differed by screening status and when screening prevalence differed according to cancer status.
Results: In the base case, person-based participation was 60 percent, while person-time participation was 42 percent of eligible person-years. Further, the study design (prospective or retrospective) also affected estimates of screening participation when loss to follow-up differed by screening status.
Conclusion: We conclude that the main contributor to differences in measures of participation is whether a person-based or person-time-based approach is used. The choice of measure should be based on the scientific question of interest. When selecting a study design, the possibility of differential loss to follow-up by screening status should be considered. To facilitate comparisons across studies, researchers should report details of measures used to compute screening participation.

The impact of eliminating cost barriers on socioeconomic disparities in colorectal cancer screening

Doubeni CA1, Gunter JM2, Field TS1, Roblin DW3, Corley DA4, Fletcher RH5
1University of Massachusetts Medical School, Worcester, Massachusetts, United States; 2LCF Research, Albuquerque, New Mexico, United States; 3The Center for Health Research-Southeast, Kaiser Permanente Georgia, Atlanta, Georgia, United States; 4Kaiser Permanente Northern California, Oakland, California, United States; 5Harvard Medical School, Boston, Massachusetts, United States

Background: Low-socioeconomic status (SES) is a well-known barrier to colorectal cancer (CRC) screening. We examined the association between SES and use of colonoscopy among persons in integrated healthcare delivery systems.
Methods: We conducted a retrospective cohort study on 100,566 men and women, 50–74 years old, who were enrolled in one of three managed care organizations in the HMO Cancer Research Network for at least 1 year as of January 1, 2000. Subjects were followed until December 31, 2007. Data on colonoscopy use were obtained from administrative records. We defined a screening colonoscopy variable as an examination not preceded by gastrointestinal conditions in the prior 6-month period. SES was measured by the percentage of households in the census-tract with incomes below 1999 federal poverty levels using 2000 United States census data. Analyses were performed using Weibull frailty models.
Results: The average age of the cohort was 60 years, and 53 percent were female. During 449,738 person-years of follow-up, fewer subjects in the lowest SES quartile (Q1) compared to the highest quartile (Q4) had any
(27 percent versus 37 percent) or a screening colonoscopy (8 percent versus 13 percent). In regression analyses, compared to Q4, subjects in Q1 were 16 percent (adjusted HR=0.84, 95 percent CI: 0.80-0.88) less likely to undergo any colonoscopy and 30 percent (adjusted HR=0.70, CI: 0.65-0.75) less likely to undergo a screening colonoscopy. There were no significant interaction effects between age or health plan and SES.
Conclusion: People in lower-SES neighborhoods are less likely to undergo colonoscopy, even among insured subjects receiving care within integrated healthcare systems.
Implications: People from low-income backgrounds are a hard-to-reach group for cancer screening outreach programs. These findings suggest that SES disparities in CRC screening may persist even if screening were offered at no cost to individuals.
Proposed Research: The impact on SES CRC screening disparities of a program of organized screening coupled with performance incentives based on predetermined screening rates is not well known. We will conduct parallel analyses of data from Kaiser Permanente Northern California (KPNC) under the auspices of a National Cancer Institute collaborative Population-Based Research Optimizing Screening through Personalized Regimens (PROSPR) research center. KPNC has a program of screening outreach that targets all eligible members. Findings from this analysis can inform the delivery of CRC screening to low-SES populations.

Mammographic screening participation rates in Europe: The EUNICE project

Giordano L[1], von Karsa L[2], Tomatis M[1], Majek O[3], de Wolf C[4], Lancucki L[5], Hofvind S[6], Nyström L[7], Segnan N[1], Ponti A[1], and the Eunice Working Group
[1]Reference Center for Epidemiology and Prevention of Cancer (CPO) Piemonte and University Hospital San Giovanni Battista in Torino, Torino, Italy; [2]International Agency for Research on Cancer, Lyon, France; [3]Institute of Biostatistics and Analyses, Masaryk University, Brno, Czech Republic; [4]Swiss Federation of Breast Cancer Screening, Bern, Switzerland; [5]NHS Cancer Screening Programmes, Sheffield, United Kingdom; [6]Cancer Registry of Norway, Oslo, Norway; [7]Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden

Background: Monitoring early indicators of effectiveness of mammographic breast cancer screening is essential to ensure the quality of the tests performed, to optimize the use of resources, and to ultimately produce an observable reduction in breast cancer mortality.
Methods: In the European Network for Information on Cancer (EUNICE), a Web-based data warehouse was developed for collection of aggregated data on implementation and performance of breast cancer screening

programmes in Europe. The parameters and indicators used are based on the comprehensive European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis. They are shown for the entire age range and for 5-year age groups and are generated in eight modules dealing with different aspects of the screening procedures including coverage and participation.
In 2008 reference persons for breast cancer screening programmes from all 27 European Member States plus Norway and Switzerland were asked to provide aggregated data describing service screening activity referred to the years 2005, 2006, and/or 2007.
Results: Eighteen European countries contacted for the survey responded. National data was provided by 10 countries: Czech Republic, Estonia, Finland, Hungary, Italy, Luxembourg, Norway, Poland, the Netherlands, and the United Kingdom. The eight other countries provided data limited to 16 regional programmes: Belgium (Flanders), Denmark (Copenhagen), Germany (pilot projects), Portugal (Centre and North), Republic of Ireland (East), Spain (Asturias, Baleares, Galicia, Navarra, Pais Vasco, Valencia), Sweden (Södermanland, Stockholm, Västmanland), and Switzerland (Fribourg). The total population targeted by the screening programme services covered in the report comprised 26.9 million women predominantly 50–69 years of age. The average participation rate across all programmes was 53.4 percent (range 19.4 percent to 88.9 percent of personally invited); the rate without one large programme that initiated invitations in 2007 (Poland) was 66.4 percent. Thirteen of the programmes achieved the European Union benchmark of acceptable participation (great than 70 percent); nine achieved the desirable level (greater than 75 percent). Despite a relatively high level of invitation coverage across all programmes (79.2 percent, range 49.6 percent to 115.2 percent), slightly less than one-half of the target population was actually exposed to the screening test (examination coverage: 48.1 percent, range 26.2 percent to 92.1 percent). The overall invitation and examination coverage without Poland was 70.7 percent and 50.2 percent, respectively.
Conclusion: The results demonstrate the feasibility of European-wide screening monitoring using the EBCM data warehouse although further efforts to refine the system and harmonize standards and data collection practices will be required to fully integrate all European countries.

Sharing information about cancer screening based on the interests of different target populations

Hamashima C
National Cancer Center of Japan, Tokyo, Japan

Background: To improve the participation rate in cancer screening programs, the target population needs to be appropriately informed. Based on public/patient involvement in other clinical guidelines, an original method was established to prepare leaflets about the Japanese cancer screening guidelines, and targeted leaflets regarding cancer screening guidelines that take into account the information required by different target groups were developed.
Methods: Before developing the leaflets, public interest data regarding cancer screening were collected using the problem solving model, the so-called KJ method developed for field surveys in Japan. The KJ method includes two steps: labeling information corresponding to specific issues and grouping similar concepts. The contents of the leaflets were edited based on the results of the KJ methods but changed in the final version according to discussions at a committee meeting involving public members. The results of the KJ method and the contents of the final version of the leaflets were compared for the following groups: cervical cancer screening targeted at 20-year-old subjects (first group); cervical cancer screening targeted at subjects aged 30 years and older (second group); and colorectal cancer screening targeted at subjects aged 40 years and older (third group).
Results: Common interests among the three groups included targeting cancer and screening methods. Although the KJ method revealed that the first group expected broad information, in the final version of the leaflet, only basic information regarding participation in cancer screening programs remained. The final versions in group 2 and 3 were similar to the first, with interest in an actual plan to participate in a screening program, including details of the screening methods, as well as physical and financial burden expected. Treatment information was initially desirable by all groups, but this information was excluded, since asymptomatic persons who participate in

screening are far from treatment. Although information regarding the harm of cancer screening was initially included according to the results of the KJ methods in the second and third groups, the first group did not expect it.
Conclusion: A targeted leaflet is a powerful tool to share appropriate information regarding cancer screening. We must understand the expectations of different target groups and prepare appropriate leaflets that support the decision to take part in cancer screening.

Tailored intervention to increase colorectal cancer screening among non-adherent populations: A randomized controlled trial

IshikawaY[1,4], Hirai K[2], Fukuyoshi J [3], Yonekura A[3], Saito H[4]
[1]Jichi Medical University, Shimotsuke, Tochigi, Japan; [2]Center of the Study for Communication Design, Support Office for Large-scale Education and Research Projects, Osaka University, Japan; [3]Cancer Scan, Tokyo, Japan; [4]National Cancer Center, Tokyo, Japan

Background: Although screening using the fecal occult blood test (FOBT) has been shown to reduce the incidence and mortality of colorectal cancer (CRC) in randomized clinical trials, the biggest remaining challenge is how to improve low participation rates. Tailored intervention is an evidence-based effective strategy that is often employed to increase participation in FOBT. However, only a few studies have examined the applicability of tailored print intervention across a range of settings and populations despite its importance. Thus, the purpose of this study was to examine the effectiveness of the tailored print intervention compared with a non-tailored print intervention in increasing the CRC screening rate among non-adherent populations.
Method: A total of 2,145 participants aged 46–66 years were recruited from a Japanese rural community. Participants were randomly assigned to either a tailored print reminder group (n=357) or a non-tailored print reminder group, which served as a control group (n=718). We employed two theory-based variables for individual assessment: intention to undergo FOBT and CRC worry. Individuals in the intervention group were divided into three segments based on the assessment. To participants with high intention (segment A) a clear information list of where/when/how they could take the screening was conveyed. For participants with low intention and bigger CRC worry (segment B), a gain-framed message that emphasized the benefits of getting FOBT, was conveyed. For participants with low intention and lower CRC worry (segment C), a loss-framed message that emphasized the cost of not getting FOBT was conveyed. Individuals in the control group were also divided into three segments for comparison with the intervention group. The primary outcome was improvement in CRC screening rates. The screening rates were examined according to treatment group (tailored versus non-tailored) and by intervention subgroups during a follow-up period of 4 months. All analyses followed the intention-to-treat principle.
Results: The number of people who underwent FOBT was 50 (14.0 percent) for the tailored group and 62 (8.6 percent) for the non-tailored group. The logistic regression model revealed that there was an advantage for tailored print reminder over non-tailored print reminder in promoting FOBT (OR = 1.72; 95 percent CI, 1.16 – 2.56). Subgroup analysis revealed similar trends in those who were assigned to tailored and non-tailored groups (Segment A: 21.1 percent and 13.5 percent; Segment B: 14.2 percent and 8.1 percent; Segment C: 10.4 percent and 6.8 percent, respectively).
Conclusions: Providing tailored print reminders was an effective intervention strategy for enhancing FOBT adoption over the untailored print reminders among non-adherent populations.

Ethnic inequalities in cervical cancer: Relation to screening coverage

Lewis HJ
Ministry of Health, Wellington, New Zealand

Background: The New Zealand National Cervical Screening Programme (NCSP) was established in 1990. Through routine screening at regular intervals, the Programme aims to detect precancerous cell changes, which if not treated may lead to cancer. The Programme works to link its component parts—smear taking, including education, invitation, and recall; laboratory testing; colposcopy; and information systems, including the NCSP Register—to

effectively meet its objectives. The Health Act 1956 underpins the NCSP's operations to ensure the coordination of a high-quality screening programme for all women. Since the introduction of the NCSP, the incidence rate of cervical cancer has fallen by about 60 percent. While the gap between Maori and non-Maori women has narrowed, ethnic inequalities persist. NCSP coverage is measured for both 3- and 5-year screening intervals for Maori and non-Maori women. This paper investigates whether coverage rate calculations at 5-yearly intervals better reflect trends in ethnic inequalities in cervical cancer incidence.
Methods: Cervical screening test results (cytology, human papillomavirus testing, histology, colposcopy) are sent to the NCSP Register (the national database for cervical screening in New Zealand) at monthly intervals. Three- and five-yearly screening coverage for enrolled women (20–69 years) by age, ethnicity, and district is calculated by the Programme, at monthly, quarterly, biannual, and annual intervals, to assist clinicians in primary care and public health units with targeting participation improvement strategies to priority women (unscreened and underscreened). This paper presents analyses of annual coverage calculations for the 11-year period 2001–2011 using Register data and Statistics New Zealand population estimates. Coverage is defined as having had a cervical screening event in the preceding 3 or 5 years. Ethnicity is defined as self-identified cultural affiliation, grouped as 'Maori' (the indigenous people of New Zealand) or 'non-Maori' (all other New Zealand residents). Cervical cancer registrations by the same age and ethnic groups for the same period were obtained from the New Zealand Cancer Registry. Coverage rates were adjusted for estimated hysterectomy prevalence. Ethnic differences in 3- and 5-year hysterectomy adjusted coverage rates are compared with corresponding differences in cervical cancer registration rates.
Results: Hysterectomy-adjusted coverage for both 3- and 5-year intervals was lower for Maori than non-Maori women throughout the study period. However, some convergence of rates was seen, especially for 5-year coverage. At the same time, the ethnic gap in cervical cancer incidence also narrowed slightly.
Conclusions: Our results suggest that monitoring 5-year coverage provides a better indicator of trends in the outcome of interest (ethnic inequalities in cervical cancer incidence), although policy is focused on 3-year coverage.
We discuss implications for social marketing and other policies aimed at improving participation in cervical screening by Maori and other 'priority' women.

Linking population-based screening registries with primary care networks: A feasibility study for a primary-care-based intervention to improve uptake and integrated screening for breast, cervical, and colorectal cancers

McGregor SE[1], Strong D[1], Bucholtz L[2], Clifford S[1], Lupul S[3], Cunning L[4], McDougall L[5]
[1]Alberta Health Services Cancer Care, Calgary, Alberta, Canada; [2]Calgary Foothills Primary Care Network (PCN), Calgary, Alberta, Canada; [3]Calgary Highland PCN, Calgary, Alberta, Canada; [4]Calgary Rural PCN, Calgary, Alberta, Canada; [5]Alberta Health Services Population and Public Health, Calgary, Alberta, Canada

Background: Primary care networks (PCNs) offer the possibility of enhancing cancer screening by allowing family physicians to work collaboratively with other health professionals to deliver health services for patients. Population-based cancer screening programs are able to monitor population screening rates and identify under-screened groups. Our preliminary work demonstrated that customized reminders and the provision to family physicians of lists of unscreened patients generated from the provincial screening program increased uptake of cervical cancer screening. However, the complexity and time-intensive work required to implement and sustain these interventions limits opportunities for a broader implementation.
Methods: This study assessed the feasibility of a practice-level intervention designed to integrate patient lists generated by the provincial cancer screening programs into a feedback and assessment system derived from the electronic medical record (EMR) to increase cancer screening in primary care. The planned business process re-design included the optimization of EMR systems and the use of allied health professionals to enhance the ability to identify and offer screening to under screened patients for three cancers (breast, colorectal, and cervical). Trained Practice Facilitators worked with eight practices in five PCNs to conduct a baseline audit of cancer screening uptake; map current and desired workflows; design and implement a change management process to improve screening; and conduct a post-intervention audit to assess changes in cancer screening uptake. Our

specific objectives were to: (1) determine the acceptability of, and ability of practices to implement, the planned intervention; (2) determine resource requirements to support the cancer screening business process change intervention; (3) develop workflow tools and templates to optimize the use of EMRs within cancer screening business processes to use as initial templates in a planned randomized controlled trial (RCT); (4) develop methods for integrating Cancer Screening Registry data into EMRs to optimize the identification of people due for cancer screening; and (5) provide preliminary estimates of design effects, magnitude of change, and screening rates needed to plan the sample size for a full scale RCT.
Results: Practice interventions are complete in three practices and will be completed in the remainder by May 2012. Findings from semi-structured interviews with key informants (physicians, office managers, allied health professionals, support staff) from each practice to obtain feedback about the intervention, the roles of allied health professionals in enhancing screening, and the chart audits will be presented. This project will determine the feasibility of the business process change and EMR optimization intervention on a scale required for an RCT.

Lessons learnt: Adapting an education resource for Western Australian Aboriginals

O'Connor K
Cancer and Palliative Care Network, Western Australia Department of Health, Perth, Western Australia, Australia

Background: This poster will outline key lessons learnt from the adaptation of a colorectal cancer (CRC) resource for Western Australian Aboriginals. CRC has a significant impact on the health of Western Australians. In 2009, 1,284 West Australians were diagnosed with CRC, while 437 died from the disease. Among the Aboriginal* population, CRC is diagnosed less frequently than in the non-Aboriginal population.[2] Age-standardised CRC mortality rate (2002–2006) for Western Australian Aboriginals is 18.4 per 100,000 compared to the non-Aboriginal Western Australian population rate of 23.9 per 100,000. Health inequity issues among Aboriginal populations are compounded by remote locations, limited education, poor accessibility, and language and cultural issues. Western Australia Health aimed to increase awareness of bowel cancer and the National Bowel Cancer Screening Program by adapting an educational flipchart to the Western Australian setting.
Methods: The Aboriginal educational flipchart "You're lookin' good on the outside, but what about the inside?" developed by Queensland Health was selected to be adapted for the Western Australian setting. Face-to-face 'yarning' and electronic consultation with Aboriginal Reference Groups of both genders from across Western Australia was undertaken over an 18-month period. Consultation identified changes recommended to enhance cultural relevance and acceptability to Aboriginals across Western Australia and engaged communities in developing the resource. A local Western Australia Aboriginal artist was commissioned to create suitable artwork. A dissemination plan was developed, including a public launch event. Independent external evaluation of the flipchart was contracted to determine its appropriateness and usability in situ (n=36).
Results: The flipchart's content and illustrations were adapted to be culturally appropriate for and relevant to Western Australia Aboriginal communities. Local artwork was used to engage the target audience. The flipchart launch, supported by an Aboriginal senior*, occurred in May 2009. Flipcharts were distributed to 198 relevant health sites including hospitals, Aboriginal Medical Service clinics, and health promotion workers across Western Australia. Independent evaluation 6 months post-implementation identified that the flipchart was well received and deemed culturally appropriate, promoting proactive health messages. Feedback identified training for health workers using the flipchart and development of complimentary material (e.g., DVD) as potential future initiatives.
Conclusions: Effective adaptation of an Aboriginal resource is time-consuming and requires continuous, extensive collaboration in culturally appropriate ways with key stakeholders to facilitate local buy-in and ownership of the process. Awareness of the extended timeframes and breadth of consultation required should be incorporated when planning. Evaluation determined tool efficacy and identified potential future initiatives.

Population-Based Research Optimizing Screening through Personalized Regimens (PROSPR): A new National Cancer Institute Initiative

PROSPR Study Investigators

Background : The United States relies primarily on screening programs that are conducted through medical care organizations, rather than through national screening programs. Consequently, there may be more diversity in program uptake and follow-up than would be found in a central program. Potential factors include use of risk assessment to guide screening strategies, patient perception of personal risk, implementation of the screening program, procedures for following positive screens, and the association of screen-detected cancers with treatment options. The Population-Based Research Optimizing Screening through Personalized Regimens (PROSPR) investigators will study the screening process for breast, colorectal, and cervical cancer in population-based settings in order to determine the impact of these factors on screening outcomes. Particular attention is directed to the impact of cancer risk on acceptance and follow-through of cancer screening.
Methods: In September 2011, the National Cancer Institute funded seven research centers and one statistical coordinating center (at the Fred Hutchinson Cancer Research Center, Seattle, Washington) to conduct this research. Three research centers focus on breast cancer screening (University of Vermont, University of Pennsylvania, Dartmouth Medical School, and Brigham and Women's Hospital). Three research centers concentrate on colorectal cancer screening (Kaiser Permanente Northern and Southern California, Group Health Research Institute, University of Texas Southwestern). One research center investigates cervical cancer screening (University of New Mexico). Each research center conducts individual research projects as well as contributes data to a pooled resource managed by the statistical center. Common data collection methods are being developed with the intent of performing cross-site collaborations. Once systems are in place, small experiments testing strategies and innovative methods will be possible.
Results: Stay tuned.
Conclusion: The PROSPR initiative has the potential to improve the entire screening process, which depends on timely and accurate follow-up of positive screens. It will be the first collaborative population-based investigation of colorectal and cervical cancer screening in the United States. The impact of actual cancer risk and perceived cancer risk on screening can be evaluated. The ultimate goal is a more seamless process of risk assessment, appropriate screening, consistent diagnostic procedures, and appropriate treatment for screen-detected cancers.

Innovative approaches to colorectal cancer screening among Alaska Native people

Redwood DG[1], Provost EP[1], Espey DK[2]
[1]Alaska Native Tribal Health Consortium, Anchorage, Alaska, United States; [2]Centers for Disease Control and Prevention, Albuquerque, New Mexico, United States

Background: Cancer is the leading cause of death among Alaska Native (AN) people, and colorectal cancer (CRC) is the leading cause of new cases of cancer. Alaska Native people are disproportionately affected by colorectal cancer, experiencing almost twice the incidence and mortality as United States Whites. Although CRC screening is an effective way to reduce CRC mortality, AN screening prevalence varies significantly between regions of the state, from 23 percent to 67 percent, with a median of 51 percent. Over the past decade, the Alaska Native Tribal Health Consortium (ANTHC) has worked to improve CRC screening prevalence through the provision of direct screening services, policy and systems changes, provider education, and community outreach.
Methods: Projects have included the development and implementation of a flexible sigmoidoscopy training program for rural mid-level providers; the provision of itinerant endoscopy services at rural tribal health facilities; the development and implementation of a CRC screening Patient Navigator project; the creation and use of a CRC first-degree relative database to identify and screen relatives of CRC patients; research studies to test new screening modalities; and the creation and dissemination of multimedia materials and health resources for CRC screening promotion among the Alaska Native population.
Results: CRC screening rates have increased 102 percent from 2000 to 2011 due to the multi-component activities of the ANTHC and its partner rural tribal health organizations.
Conclusion: Lessons learned from past projects include the need for patient navigation and to address capacity and systems barriers. Further research and programs should address barriers to screening and expand the CRC screening options available to Alaska Native people. These efforts will increase CRC screening prevalence and, ultimately, decrease the excess morbidity and mortality caused by CRC among the Alaska Native population.

Smokers' compliance in a multiphasic cancer screening study

Rozjabek HM, Marcus PM
National Cancer Institute, Bethesda, Maryland, United States

Background: Researchers have long believed the notion that an individual's health behavior choices reflect his/her perceived risk and the importance the individual places on overall health and health risk prevention. Previous studies have shown cigarette smokers, compared to non-smokers, were more likely to engage in unhealthy behaviors and be risk takers. Recent studies have found that smoking is associated with cancer screening behaviors and smokers are less compliant with following screening guidelines compared to non-smokers. However, results from these studies have been mixed, and research has primarily focused on women and mammography. No research has been done on a multiphasic screening program.
Methods: The Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial was a randomized multisite, two-arm trial conducted to analyze the effect of screening for prostate, lung, colorectal, and ovarian cancer on disease-specific mortality. The data set contains screening information on the 77,445 men and women in the intervention arm who were eligible to receive a screening exam for lung, colorectal, ovarian, or prostate cancer. Participants were followed for up to 13 years and were offered screening exams throughout the first 6 years of the study.
Results: Overall, at the time of the first screening exams, 87.79 percent of males and 81.63 percent of females completed all of their expected screening exams, including chest x-ray, flexible sigmoidoscopy, prostate-specific antigen, cancer antigen-125, digital rectal exam, and transvaginal ultrasound. Looking at compliance by smoking status showed 85.60 percent of never smokers completed all of their expected exams, 85.03 percent of former smokers completed all exams, and 79.81 percent of current smokers completed all exams. Among males, 89.56 percent of never smokers completed their screening exams compared to 87.79 percent of former smokers and 83.18 percent of current smokers. Compliance rates among females were lower compared to males. Only 83.05 percent of female never smokers completed their screening exams compared to 80.98 percent of former smokers and 75.83 percent of current smokers.
Conclusion: The implications of this research translate into the community setting. Information on screening compliance can be used to identify individuals who may be at a higher risk of not following recommended screening guidelines. Smokers are already at a higher risk of developing certain cancers, and screening within this population is especially important for early detection. In addition, interventions can be designed and implemented to increase cancer screening rates among smokers.

Improving breast cancer screening rates: A systematic and multifaceted approach

Schottinger J, Kanter M, Goldberg R
Southern California Permanente Medical Group, Pasadena, California, United States

Background: Breast cancer screening with mammography has been demonstrated in many large randomized controlled trials to decrease breast cancer mortality, but despite this compelling evidence, mammography screening rates in the United States have been declining. Kaiser Permanente Southern California (KPSC) provides comprehensive prepaid medical care to 3.6 million socioeconomically diverse members, with an emphasis on evidence-based medicine and a commitment to prevention and wellness. In 2004, the National Health Interview Survey reported that mammogram screening rates dropped to 66 percent. The KPSC rates were 76 percent (HEDIS, aged 52–69) at year end 2003, leading KPSC to embark on a systematic approach to increase screening rates.
Methods: Senior leadership set a clear vision and goal for KPSC to become the best in the country for breast cancer screening. Resources and equipment were assessed, with a focus on productivity and maintenance of access, including walk-in capability for appointments. In some areas, mobile mammography and additional machine purchases were necessary. Bimonthly physician specific reports and rates provided feedback to physicians and leadership. A centralized regional outreach program sent every woman due for mammogram screening a letter and automated reminder call. A formal process called the "proactive office encounter" was developed and deployed first in primary care and then all specialty departments. A women presenting at any office who has a care

gap identified in the electronic medical record has her mammogram appointment arranged by the office support staff, who often walk the patient directly to radiology for a "no escape" policy.
Results: The breast cancer mammography screening rates for women aged 52–69 rose from 76 percent to 88 percent by 2007 and have consistently been maintained at 89–90 percent since that time. The percentage of women diagnosed with stages 0 and 1 breast cancer rose from 53 percent in 2003 to 61 percent in 2007.
Conclusion: Significant increases in breast cancer screening rates in a large population of socioeconomically diverse women were achieved, with an increase in detection of earlier stage lesions. The approach involved strong leadership setting an organizational goal with commitment of resources, robust outreach, and proactive prompts for prevention at all visits in the system.

Prevalence of hysterectomy among Canadian women and its impact on monitoring cervical cancer screening performance

Stankiewicz A[1], Pogany L[1], Popadiuk C[2]
[1]Public Health Agency of Canada, Ottawa, Ontario, Canada; [2]Memorial University, St. John's, Newfoundland, Canada

Background: Hysterectomy is one of the most frequently performed surgical procedures among Canadian women, whose consequence is the creation of a population that no longer requires, at least for the majority of them, cervical cancer screening. The objective of this analysis was to estimate the overall prevalence of hysterectomy among Canadian women (20 to 69 years old and age-specific) by province and territory over time in order to provide more accurate estimates of eligible participation in cervical screening.
Methods: Self-reported hysterectomy prevalence was obtained from the 2001, 2003, and 2008 Canadian Community Health Surveys. Overall (20 to 69 years) and age-specific prevalence and 95 percent confidence intervals (CI) were estimated for Canada and provinces and territories for the three time periods.
Results: Among Canadian women aged 20 to 69, self-reported hysterectomy prevalence declined from 14.7 percent (95 percent CI: 14.3-15.2) in 2001 to 12.8 percent (95 percent CI: 12.2-13.4) in 2008. Interprovincial variations in hysterectomy prevalence were observed among women in each age group and time period. Among women aged 50 to 59, prevalence was as high as 35.1 percent (95 percent CI 25.8-44.3) in 2008 and appeared to have decreased in all regions from 2001 to 2008.
Conclusion: Interprovincial and time-period variation demonstrates the importance of utilizing accurate hysterectomy prevalence for calculating cervical cancer screening participation.

Mailed invitations to be screened for colorectal cancer improve uptake in population-based screening program

Tinmouth J[1], Paszat L[2], Baxter NN[3], Sutradhar R[4], Yun L[4], Rabeneck L[4]
[1]Cancer Care Ontario, Toronto, Ontario, Canada; [2]Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada; [3]St. Michael's Hospital, Toronto, Ontario, Canada; [4]Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

Introduction: A central tenet of organized cancer screening programs is that all members of the target population be invited to be screened. While mailed invitations for colorectal cancer (CRC) screening have been shown to be effective in randomized controlled trials, to date, their effectiveness has not been reported in population-based studies. The aim of this study is to evaluate the effectiveness of mailed invitations for CRC screening in a population-based CRC screening program.
Methods: In 2008, Ontario launched its organized province-wide CRC screening program, ColonCancerCheck (CCC). In November 2009, CCC conducted a technical evaluation ("the Pilot") of large-scale, mailed invitations asking patients to visit their family physician to arrange CRC screening. The Pilot comprised 102 family physicians and all their associated eligible patients (i.e., aged 50 to 74 years, due for screening, no prior CRC). In the current study, we linked the records of the Pilot patients to provincial health administrative records. Patient and physician factors associated with response to the mailed invitation were identified using logistic regression adjusting for

clustering of patients within physicians. Using propensity scores to match in a 1:1 fashion, we then selected a control group of eligible patients from family physicians who did not participate in the Pilot. CRC screening uptake was compared between Pilot patients and matched controls using McNemar's test.
Results: There were 11,302 eligible patients in the Pilot cohort. Median age (interquartile range) was 58 years (53–64); 5,853 (52 percent) were female, and 1,548 (14 percent) completed an FOBT previously (from 2 to 5 years prior). Two thousand five hundred and three (22 percent) completed an FOBT within 6 months of the mailed invitation. Factors significantly associated with uptake of FOBT included older patient age (70–74 versus 50–59 years old: OR 1.6, 95 percent CI: 1.3 - 2.0), greater patient co-morbidity (greatest versus no co-morbidity: OR 1.6, 95 percent CI: 1.3 - 2.0), having a female physician (OR 1.3, 95 percent CI: 1.04 - 1. 6), lack of intercurrent hospital admission (OR 3.5, 95 percent CI: 2.2 - 5.6), and prior FOBT (OR 2.8, 95 percent CI: 2.5 - 3.3). In the matched analysis, Pilot patients were more likely to complete an FOBT within 6 months of mailed invitation than matched controls (22 percent versus 7 percent, $p<0.0001$). Benefit was maintained when the definition of uptake of CRC screening included FOBT or colonoscopy within 6 months of invitation (25 percent versus 10 percent, $p <0.0001$). Seven invitations were mailed for each additional person participating in screening.
Conclusion: Mailed invitations improved the uptake of CRC screening in this provincial population-based CRC screening program. Organized CRC screening programs may wish to use mailed invitations to improve patient participation.

Quality control of colonoscopies in the national colorectal cancer screening program in the Czech Republic

Vojtechova G[1,2], Suchanek S[1,2], Majek O[3], Dusek L[3], Zavoral M[1,2]
[1]Charles University, Prague, Czech Republic; [2]Military University Hospital, Prague, Czech Republic; [3]Institute of Biostatistics and Analyses, Masaryk University, Brno, Czech Republic

Background: The Czech Republic ranks the top position in world statistics in colorectal cancer (CRC) incidence and mortality. An organized screening program was introduced in 2000. The quality of screening colonoscopy (SC) was evaluated based on two indicators – adenoma detection rate (ADR) and caecal intubation rate (CIR). The upper limit for participation in a screening program is 50 screening colonoscopies per year. The aim of our analysis was to determine whether ADR and CIR of specific examiners correlate with the quantity of performed procedures and the way in which these results are described by individual colonoscopic screening centers.
Methods: Data were analyzed from the colorectal cancer screening program in the Czech Republic. Both endoscopists and screening centers were divided into five groups according to the number of patients examined. ADR and CIR of individual examiners and screening centers respectively were calculated.
Results: In 2010, 500 endoscopists in 185 screening centers performed a total of 17,876 screening colonoscopies. Average individual ADR and CIR was 33.6 percent and CIR 95.1 percent resp. In the group of examiners with least performed SC (1–25 per year) ADR was 33.3 percent. In examiners with 26–50 procedures per year, ADR was 34.9 percent. In the group with 51–75 examinations per year, ADR was 35.2 percent. In groups with the highest number of performed procedures (76–150 and more than 150 per year), ADR was 34.8 percent and 30.8 percent, respectively. ADR correlates with the experience of colonoscopic specialists; however, in the group with the highest count of procedures, quality did not correlate with quantity. Individual CIR strongly correlates with experience; the group with more than 150 SC per year achieved 96 percent CIR. In the low-volume centers (50–75 SC per year), ADR of 36.4 percent was recorded. On the contrary, centers with high-volume SC numbers (more than 200 per year) achieved the lowest ADR (31.2 percent). The total ADR of endoscopic centers did not correlate with the quantities of SC.
Conclusion: Our analysis shows that even smaller centers are able to maintain high standards of screening colonoscopies, and no changes in minimum requirements for centers to participate are necessary.

Strategy to increase cancer screening among populations from culturally and linguistically diverse (CALD) backgrounds

Voloschenko A
Queensland Health, Brisbane, Queensland, Australia

Background: Cancer is a costly disease both in terms of treatment, life years lost, and the impact on the community and the health system. Cancer screening can reduce morbidity and mortality from cancer of the cervix, breast, and bowel if the eligible population participates in regular screening (*The Health of Queenslanders 2010,* Queensland Government).
Twenty-eight percent of the Australian population comes from culturally and linguistically diverse (CALD) backgrounds. It is widely recognised that people from CALD backgrounds are less likely to participate in regular cancer screening. Cancer screening is not available in most countries from which refugees and migrants come, and it is feared and poorly understood.
Methods: A literature review and needs analysis was performed to assess knowledge, attitudes, and barriers to cancer screening to guide the development of strategies to create awareness and increase participation of communities from CALD backgrounds in cancer screening throughout Queensland. This identified language difficulties; a fatalistic view of health, cultural, and religious practices; lack of understanding of the disease process; poor health awareness; and unfamiliarity with health services as major contributors to low or non-participation in cancer screening.
On the basis of this information an education strategy was developed in partnership with Ethnic Communities Council of Queensland (ECCQ), and South Brisbane TAFE English Language and Literacy Services (TELLS) was developed.
Results: The findings of the needs analysis and education strategy will be presented along with culturally appropriate resources.

Monitoring compliance in population-based cancer screening programmes with multiple rounds: Proposed indicator for standard reporting

von Karsa L[1], Suonio E[1], Sighoko D[1], Ducarroz S[1], Lignini T[1], Anttila A[1,2]
[1]International Agency for Research on Cancer, Lyon, France; [2]Finnish Cancer Registry, Helsinki, Finland

Background: Rates of participation and coverage are established parameters that reflect the extent to which a target population is exposed to screening. However, it commonly takes 10 years or more to establish a population-based programme for breast, cervical, or colorectal cancer screening over a country or region. And with the exception of screening in low-resource settings, or some endoscopic screening programmes, most protocols currently entail multiple screening rounds. It therefore generally takes many more years to be able to fully assess the impact of a screening programme. In countries with sufficient resources to implement programmes with multiple screening rounds, monitoring compliance requires a multi-year perspective and ideally should help policy makers and programme managers accurately recognize the scale of the potential impact of the programme as early as possible. This should permit more effective management of performance and provide earlier indications of the actual limits to the benefit side of the balance.
Methods: An indicator of compliance and a standard tabular format for reporting over time are therefore proposed using the example of cervical cancer screening and based on experience in the European Cancer Network.
Results: Average annual coverage of the 30- to 49-year-old population by screening examination. Average coverage over a time period equal to the duration of a round adopted in a screening programme (3, 5, or more years) should also be provided. The numerator is the number of women screened in the respective time period; the denominator is the number of women in the target population in the respective time period. Rates are calculated and reported as totals and broken down by the number of rounds previously attended.
Conclusion: The age range of the indicator corresponds to that of the global indicator for cervical cancer screening proposed by the World Health Organization for the prevention and control of noncommunicable diseases and is relevant for countries at all resource levels that implement cervical cancer screening. The tabular, multi-year reporting format is particularly suited to monitoring compliance over time, especially in the rollout phase of programmes. The same fundamental approach can be taken to monitoring compliance of any screening

programme, such as for breast and colorectal cancer, and it can be adapted to programmes with a single round of screening.

Perceived risk of breast cancer and breast cancer screening behaviours among female relatives from the Ontario Familial Breast Cancer Registry

Walker MJ[1], Chiarelli AM[1], Mirea L[2], Glendon G[1], Ritvo P[1], Andrulis IL[2], Knight JA[2]
[1]Cancer Care Ontario, Toronto, Ontario, Canada; [2]Mount Sinai Hospital, Toronto, Ontario, Canada

Background: A majority of studies that have previously examined the relationship between perceived breast cancer risk and breast screening among women with familial breast cancer risk have been cross-sectional, limiting insight into directionality of this relationship. The purpose of this study is to assess the prospective association between perceived breast cancer risk and subsequent use of screening mammography, clinical breast examination (CBE), and BRCA genetic testing.
Methods: A population-based cohort of relatives of invasive breast cancer cases from the Ontario Familial Breast Cancer Registry were followed for 3 years by telephone-administered questionnaire. Women were Ontario residents, aged 20–69 and unaffected by breast cancer at the time of their relative's diagnosis. Final sample sizes included n = 1114, n = 975, and n = 882 women at baseline, year 1, and year 2, respectively. Women were excluded if they did not have a first-degree familial breast/ovarian cancer history, had a personal breast cancer diagnosis, or underwent bilateral mastectomy. Associations between perceived lifetime risk of breast cancer (measured on numeric and Likert-type verbal scales) and use of breast screening tests were estimated using multivariate multinomial regression models, with the least vigilant screening categories comprising the reference group. Further analyses will examine the potential modifying effect of level of familial breast cancer risk on the association between perceived risk and screening behaviours. Multivariate models are adjusted for potential confounders, and estimates of precision are corrected for familial clustering.
Results: Preliminary results indicate that women who rated their numeric perceived risk as more than 50 percent versus less than 50 percent at baseline were approximately twice as likely to report a screening mammogram within the past 12 months at year 1 (OR = 2.09; 95 percent CI: 1.05-4.17). Women who rated their perceived risk as "above/much above average" at baseline were also significantly more likely to report a screening mammogram in the past 12 months at year 1 (OR = 2.23; 95 percent CI: 1.32-3.76), compared with women who rated their risk as "much below/below/same as average." No significant associations were observed between numeric or verbal perceived risk at baseline and use of CBE or genetic testing at year 1.
Conclusions: Results provide insight regarding the influence of perceived breast cancer risk on breast cancer surveillance activities of women at high risk of breast cancer due to familial history. This may guide improved strategies for risk-communication to achieve optimal screening rates leading to early detection for women with familial risk.

Colorectal Cancer Cost

The net cost of increasing colorectal cancer screening rates in community health centers

Brown PM[1], Kohler RK[2], Rohweder C[2], Weiner B[2]
[1]University of California, Merced, California, United States; [2]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States

Background: Low screening rates in community health centers in the United States represent a lost opportunity to reduce colorectal cancer (CRC) mortality and morbidity among minority, low-income, and uninsured Americans. The current research project aims to introduce an evidence-based strategy for implementing office-system changes that has been shown to use fewer resources and achieves higher screening rates than other approaches. The purpose of this report is to present evidence on the net cost to community health centers of adopting the new approach and expanding the current CRC screening activities.
Methods: We use a resource-based approach that estimates the resources associated with each stage of the CRC screening process or implementation activity and applies a unit price to each resource to get the total cost associated with current and new screening. The net benefit [(ScreeningRevenusPre – ScreeningCostsPre) - (ScreeningRevenuesPost – ScreeningCostsPosts)] of each CRC screening process is assessed by comparing the resources associated with CRC screening pre- and post-implementation and the change in revenues generated from the increased activity. The revenue from the additional screening will be the number of individuals screened multiplied by a reimbursement rate (e.g., Medicaid). The robustness of the results is reported using sensitivity analysis on key parameters associated with the costs and benefits (e.g., revenues and number of people screened) to the clinic.
Conclusion: This research project has significant potential to contribute to scientific knowledge about how the office-systems approach works and the cost to providers of changing their current system of delivering CRC screening.

Costs of colorectal screening: International comparisons of ICSN countries

Kohler RK[1]; Brown PM[2]; Zauber A[3]; Brown M[4]
[1]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States; [2]University of California, Merced, Merced, California, United States; [3]Memorial Sloan-Kettering Cancer Center, New York, New York, United States; [4]National Cancer Institute, Bethesda, Maryland, United States

Background: Understanding the costs of colorectal cancer (CRC) screening programs is imperative for policy makers and funders when deciding whether to continue or expand existing screening efforts. While the organization and coverage of CRC screening programs vary across countries, shared insight of the program components and resources used in different settings could provide guidance to improve CRC screening initiatives worldwide.
This study aimed to identify and describe resources and unit costs associated with CRC screening across countries that participate in the International Cancer Screening Network (ICSN). This report focuses on the differences in costs of fecal occult blood tests (FOBT) or fecal immunochemical test (FIT) and colonoscopy, as these were the most commonly used screening methods.
Methods: An online questionnaire was administered to country representatives from 27 member countries after pilot testing the collection tool at a special interest meeting developed at the 2010 ICSN conference. Respondents were also asked to submit cost reports from their country or region that might include the components of CRC screening programs. Estimates of Purchasing Power Parity exchanges rates were used to convert costs to 2010 International Dollars.
Results: Information regarding screening program details was more commonly reported than specific cost data. The unit cost of the screening modalities varied greatly across country sites and studies: FOBT/FIT ranged from $1 to $43, and colonoscopy ranged from $84 to $1,865. Reported program costs in the United States were generally higher than European and other countries.

Conclusion: The estimates suggest there is significant variation in the unit costs associated with each screening modality and consequently the overall program costs. Future analyses using a micro-costing approach would provide program cost clarity to the wider health community to expand CRC screening.

Ductal Carcinoma In Situ

Are screen-detected DCIS of the breast different? A population study

Ponti A[1], Pitarella S[1], Paci E[2], Segnan N[1], and the Impact Project Working Group
[1]Reference Center for Epidemiology and Prevention of Cancer (CPO) Piemonte, Torino, Italy; [2]Cancer Prevention and Research Institute (ISPO), Florence, Italy

Background: Incidence of ductal carcinoma in situ of the breast (DCIS) has dramatically increased as result of introduction of mammographic screening. The impact of this increased detection on reduction of breast cancer mortality on one hand and on overdiagnosis and overtreatment on the other is matter of current debate. The aim of this study is to assess histopathology characteristics and treatment in a large population-based series of DCIS and to compare these indicators between screen-detected and clinical cases.
Methods: This analysis has been conducted within the Italian population-based multicentre Impact project, including 22 different Areas, where both a population cancer registry and a population breast cancer screening program database are available. Incident breast cancer cases diagnosed in a period ranging from 1988 to 2006 were collected and linked to screening history. For the purpose of this study we selected from the Impact project database in situ and microinvasive carcinoma (MI) that have been diagnosed as first breast tumours in women ages 50–69 in Areas that provided data during both non-screening and screening periods and that had at least 30 in situ cases. We classified cases as either screening-detected (SD) or else (NSD). Cases were SD if they were detected following invitation in the first or subsequent screening test. Cases were classified as NSD if they were diagnosed outside the screening process (not invited, not respondents, or interval cancers).
Results: We collected 2,991 incident DCIS, 321 lobular carcinoma in situ, and 545 MI from the eleven Areas that met the eligibility criteria. We performed multivariate logistic regression comparing SD versus NSD cases. SD CIS have lower probability of having lobular morphology (OR=0.66; 95 percent CI 0.51-0.85). SD DCIS have higher chance of presenting high nuclear grade (OR= 1.53 95 percent CI 1.18-1.99). No different probability of having comedo morphology between SD and NSD DCIS was found (OR= 0.92 95 percent CI 0.68-1.26). SD DCIS have higher probability of receiving breast-conserving surgery (OR= 1.56 95 percent CI 1.25-1.95) and sentinel lymph nodes biopsy (OR=1.56 95 percent CI 1.13-2.15), while the risk of axillary lymph nodes dissection is not different in the two groups (OR= 1.05 95 percent CI 0.81-1.35).
Conclusion: Biological aggressiveness, as measured by nuclear grade, is higher in our study for SD versus NSD cases. Differences in surgical treatment may be related to greater referral to high volume specialized hospital for cases referred by organised screening programs.

Biomarkers

Statistical study design considerations in evaluating biomarkers for their clinical utilities in cancer screening process

Feng Z
Fred Hutchinson Cancer Research Center, Seattle, Washington, United States

Background: Evaluating a biomarker for cancer screening commonly refers to its performance in average risk population screening. Few biomarkers have adequate specificity and sensitivity for this purpose. However, in the context of cancer screening process that including initial screening in average risk population, triaging after abnormal findings (e.g., elevated prostate-specific antigen for prostate cancer, pulmonary nodule from computed tomography scan) or high-risk population under surveillance (e.g., hepatitis B/hepatitis C/cirrhotic patients without symptom for liver cancer), the potential applications of biomarkers are greatly broadened. However, the study design considerations vary accordingly due to different clinical contexts.
Methods: Drawing from several biomarker validation trials for prostate, colon, liver, lung, and pancreatic cancers in the Early Detection Research Network (EDRN) in the United States, we illustrate how the principles of prospective-specimen-collection, retrospective-blinded-evaluation (PRoBE) study design were used in the statistical study designs for these trials. The key elements of these principles are: (i) clinical context; (ii) performance criteria; (iii) biomarker test; and (iv) study power and termination.
Conclusion: The PRoBE study design standards can be used to evaluate biomarker clinical utilities in the full spectrum of cancer screening process, eliminate biases, and improve consistency in the quality of these trials.

Development of a biorepository within a colorectal cancer screening program to support the development and validation of novel non-invasive colorectal cancer screening tests

Hilsden RJ[1,3], McGregor SE[2], Town S[3], Paszat L[4], Rabeneck L[4]
[1]University of Calgary, Calgary, Alberta, Canada; [2]Alberta Health Services, Calgary, Alberta, Canada; [3]Forzani & MacPhail Colon Cancer Screening Centre, Alberta Health Services – Calgary Zone, Calgary, Alberta, Canada; [4]Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

Background: Biomarkers hold the promise to transform colorectal cancer (CRC) screening, supplanting stool-based tests as a more effective method of identifying those at high risk for CRC neoplasia, while being more acceptable to the target population. Due to the risk of bias in biomarker discovery, it is critical that promising biomarkers be subjected to critical and rapid evaluation in a screening-relevant population so that those that are inaccurate can be abandoned and those that remain promising can be evaluated in clinical trials. This study aimed to describe the development of a biorepository of blood, urine, and tissue linked to comprehensive risk factor and outcome data to support the development and validation of novel non-invasive CRC screening tests.
Methods: The biorepository is located at the Forzani & MacPhail Colon Cancer Screening Centre (Calgary, Canada), an endoscopy unit dedicated to providing colon cancer screening-related colonoscopies as part of the province's colorectal cancer screening program. The initial focus was on recruiting asymptomatic, average risk individuals, who would represent the target group for a CRC screening test. Recruitment has now expanded to recruitment of those with a family history of CRC or a positive fecal occult blood test to increase the number of outcome events. Participants complete comprehensive questionnaires on their health and life-style, family history, diet (United States National Cancer Institute Food Frequency Questionnaire), physical activity (International Physical Activity Questionnaire), medications, and nutritional supplements and provide blood and urine samples prior. Blood is fractionated into serum, plasma, whole blood, and buffy coat and stored at -80C. Participants undergo colonoscopy with removal of all polyps between 2 and 180 days after collection of blood and urine. Normal colonic biopsies are obtained on a subset. Formalin-fixed tissue is available from all polyps removed. Subsequent linkage to the provincial cancer registry will identify interval cancers. Samples can be obtained based on specific

participant characteristics or neoplasia status. It is possible to tailor data or sample collection to meet the needs of specific projects.
Results: Over 1,700 subjects have been recruited since October 2008. The cost for recruitment and collection of specimens and subject data is $130/subject and $180/subject if fresh tissue biopsies are collected. The most advanced neoplasia status of recruited subjects is advanced adenoma 2.2 percent, non-advanced adenoma 23 percent, hyperplastic polyps 9 percent, and normal 65 percent.
Conclusion: The biorepository holds biologic specimens and a wealth of epidemiological data on a well-characterized cohort of subjects that could support research into the etiology, prevention, and early detection of colorectal cancer.

Genetic determinants for fibroglandular breast tissue volume: Implications on the use of mammographic density in breast cancer risk assessment

Kontos D, Keller B, Domchek SM, Chen J, Handorf E, Jones M, Boghossian L, Armstrong K, Conant E
University of Pennsylvania, Philadelphia, Pennsylvania, United States

Background: Mammographic density has been shown to be a strong risk factor for breast cancer. However, the biological determinants underlying this association are not yet fully understood. We investigate potential genetic determinants of mammographic density, by investigating the association between imaging measures of fibroglandular tissue volume and a series of validated single nucleotide polymorphisms (SNPs) associated with established breast cancer susceptibility loci.
Methods: Bilateral two-view full-field digital mammography (FFDM) images were retrospectively analyzed under Health Insurance Portability and Accountability Act (HIPAA) and Institutional Review Board (IRB) approval from 433 women (59.6 percent Caucasian, 40.4 percent African American, Age 53±7yrs, Gail Risk Lifetime Risk 10.4±4.4) with a negative screening exam who had results available from a validated genetic assay for breast cancer risk assessment (deCODE BreastCancer, deCODE genetics, Inc.). This genetic assay measures the allelic variation for 12 validated single-nucleotide polymorphisms (SNPs) previously associated with breast cancer risk. Fibroglandular breast tissue volume, both in terms of relative (percent) and absolute amount, was measured on a per-breast basis using validated United States Food and Drug Administration-approved automated software (QuantraTM, Hologic, Inc). The fibroglandular tissue measures were averaged between the left and right breasts for each woman to create corresponding measures on a per-woman basis. Associations between each SNP and the fibroglandular tissue measures were assessed with univariate linear regression. Model adjustments were considered for age, ethnicity, and Gail lifetime risk. Bonferroni correction was also applied to adjust for multiple comparisons across the different models.
Results: Statistically significant associations ($p<0.05$) were found between absolute amount of fibroglandular tissue volume and 6 SNPs, from which two retained significance after Bonferroni correction ($p<0.004$). When further adjusting for age, ethnicity and Gail risk, one SNP, specifically the rs3803662 in the TNRC9 gene, retained significance (regression: coefficients $p<0.05$, model $p<0.001$). The rs3803662 SNP has been previously associated with estrogen-receptor (ER) status and metastatic disease. No association was found between any of the SNPs and the relative (e.g., percentage) amount of volumetric fibroglandular tissue content.
Conclusion: Our results indicate that specific breast-cancer related SNPs may be associated with mammographic density. This association may be more direct with the absolute rather than the relative amount of fibroglandular tissue volume, suggesting that absolute measures of fibroglandular tissue may result in more accurate measures of breast cancer risk. Comparison with standard area-based mammographic percent density measures is warranted, and currently underway at our institution, to fully test this hypothesis. Identifying genetic determinants of fibroglandular tissue can elucidate biological pathways associated with cancer risk and guide targeted treatments for breast cancer risk reduction and prevention.

Biomarkers of gastric carcinogenesis for risk assessment and early detection

Paszat L[1,2], Rabeneck L[2], Graham DY[3], Lundin S[4], Mills JC[5], Jones N[2], Rugge M[6], Fassan M[6], Palacios R[7], Morales G[7], Guillen R[3], Gonzalez C[3]

[1]Institute for Clinical Evaluative Sciences Toronto, Ontario, Canada; [2]University of Toronto, Toronto, Ontario, Canada; [3]Baylor College of Medicine, Houston, Texas, United States; [4]Gothenburg University, Gothenburg, Sweden; [5]Washington University, St. Louis, Missouri, United States; [6]University of Padova, Padova, Italy; [7]Universidad Nacional Autonoma de Nicaragua, Managua, Nicaragua

Background: Helicobacter.pylori is highly prevalent in many low and low-middle income countries, and gastric cancer mortality is high among many of these. Transmission is very early in life, and some infected persons go on to chronic gastritis, atrophy, metaplasia, dysplasia, and invasive cancer. Detection and treatment of the infection and neoplasia are difficult at best, and resources for them are deficient in these settings.
Methods: We have assembled a collaboration with a long-term goal as the development of cheap, point-of-contact screening for risk and early detection in these settings. We include investigational microbiologists, immunologists, molecular biologists, molecular pathologists, cancer epidemiologists, and clinicians. We and our institutions are sharing financial and other resources to achieve proper collection, storage, and analysis of appropriate and sufficient biospecimens. We have strong collaborative relationships with the university, hospitals, and health care professionals in Managua, Nicaragua, where we prospectively recruit study subjects and collect biospecimens. We are collecting blood in population surveys to identify the likely presence of atrophy of the gastric corpus by pepsinogen levels among various regions of the country. We are collecting whole blood and gastric tissue (normal to invasive cancer) among cohorts of patients undergoing gastroscopy and/or gastrectomy in Nicaragua. In order to identify potential biomarkers for risk assessment/early detection, and possibly for intervention, we are analyszing properly collected and stored blood and tissue for immunological (cytokines, chemokines), microbiological (culture, PCR), and other molecular analyses (microRNA extraction and expression, immunohistochemistry, molecular pathology). The biospecimens are sufficiently generous to allow the illumination of biomarkers identified by one scientific perspective with analyses from multiple other perspectives to enhance the ability to understand what each biomarker represents in terms of the process from gastritis to cancer. The eventual goal is to identify biomarkers of the time at which gastric cancer is preventable and markers of early carcinogenesis.

Assessment of novel biomarker panels for early detection of colorectal cancer (CRC) in human blood samples

Purins LR[1], Tabor B[2], Priebe I[1], Pompeia C[1], Brierley G[1], Lockett T[3], Nice E[4], Adams T[5], Burgess A[6], Gibbs P[6,7], Tie J[6,7], Ruszkiewicz A[9], Moore J[9], Cosgrove L[1]
[1]Preventative Health National Research Flagship, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Food and Nutritional Science, Adelaide, South Australia, Australia; [2]CSIRO Mathematical and Information Science, Sydney, New South Wales, Australia; [3]Preventative Health National Research Flagship, CSIRO Food and Nutritional Science, Sydney, New South Wales, Australia; [4]Monash University, Melbourne, Victoria, Australia; [5]CSIRO Materials Science and Engineering, Melbourne, Victoria, Australia; [6]Ludwig Institute for Cancer Research, Melbourne, Victoria, Australia; [7]Royal Melbourne Hospital, Melbourne, Victoria, Australia; [8]SA Pathology, Adelaide, South Australia, Australia; [9]Royal Adelaide Hospital, Adelaide, South Australia, Australia

Background: Colorectal cancer (CRC) is a treatable disease if detected early, and presently it is the second-most prevalent cancer in the developed world. In Australia, it causes over 4,000 deaths annually and worldwide approximately 500,000 deaths with an annual incidence of one million cases. A widely used non-invasive screening test for CRC is the faecal occult blood test (FOBT), and even though screening with FOBT has been shown to lead to reductions in CRC incidence and mortality, there are drawbacks relating to its use as a diagnostic screening tool. Significantly, there is a low compliance rate, it has a low positive predictive value for suspected cancers, and it also requires more than one stool sample to achieve sensitivity. We believe that a blood test may overcome some of the limitations of the FOBT and/or provide a useful adjunct to FOBT. As such we are aiming to identify a sensitive panel of protein CRC biomarkers in blood to detect patients with early disease when surgery and therapy is most likely to be effective.
Methods: Analysis of gene and protein expression profiling data and literature searches has enabled us to identify 55 potential CRC biomarkers. The proteins identified encompass secreted, membrane-cleaved immune markers

and growth factors and represent a spectrum of biological processes involved in colorectal malignancy. Serum and plasma was collected from two cohorts of CRC patients (Dukes stages A–D) and age and gender matched healthy controls over 6 years (2005–2010, total n = 345) and was analysed using immunoassays (either ELISA or Luminex multiplex format).
Results: Fifteen single biomarkers showed significant differences between median values in CRC and controls, but no single biomarker alone was considered to have adequate performance for diagnostic purposes. However, using logistic regression we have identified panels that show very good performance and are now under development as a combined biomarker blood test. Collection of samples for validation from a new cohort of patients undergoing colonoscopy is now being implemented across two states in collaboration with our clinical partners and the Victorian Cancer Biobank.

The Prostate, Lung, Colorectal and Ovarian (PLCO) cancer screening trial biorepository of high-quality biospecimens

Yurgalevitch SM[1], Carrick DM[1], Prorok P[2], Zhu C[2], Huang WY[2], O'Brien B[1]
[1]Westat, Rockville, Maryland, United States; [2]National Cancer Institute, Bethesda, Maryland, United States

Background: The National Cancer Institute's (NCI) Division of Cancer Prevention (DCP) has established a 21-year trial, the Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Trial, to determine the effects of screening on cancer-related mortality and cancer incidence. Ten screening centers located across the United States enrolled approximately 77,500 men and 77,500 women, ages 55 to 74, and randomized them to either a screening or control (standard care) arm. NCI's Division of Cancer Epidemiology and Genetics (DCEG) and DCP established the PLCO Etiologic and Early Markers Study (EEMS) to facilitate research using collected blood, buccal cells, and tissue. In 2005, NCI opened the PLCO Biorepository, containing over 2.4 million biospecimens, to the broad scientific community to enable diverse investigators to pursue cancer etiology and early marker research.
Methods: Blood specimens were collected prior to the diagnosis of PLCO cancers. Serial blood specimens were collected over six annual visits. Detailed demographic, dietary, family history of cancer, and other subject-related data were collected. PLCO established policies and procedures for investigators to access biospecimens and associated data. This includes a scientific review process, pre-defined evaluation criteria, and procedures for obtaining biospecimens and data. Web-based study- and specimen-tracking systems facilitate tracking of the large number of studies.
Results: Since the inception of EEMS, over 150 proposals for ancillary studies in a wide range of scientific areas have been received**.**
Conclusion: The EEMS study review and specimen tracking processes have successfully facilitated access to PLCO biospecimens and associated epidemiologic data for a wide variety of investigators, thereby adding to our knowledge about cancer etiology and early markers. A detail description of the process will be included in the poster presented.

Audit Feedback on Reading Performance of Screening Mammograms

How to adjust mammography-audit recommendations in population with different incidence rates?

Chen C-Y, Chen C-H, Wu W-L, Mak C-W, Tzeng W-S
Chi-Mei Medical Center, Tainan, Taiwan

Background: To monitor the screening mammographic outcome is an effective way to get the feedback directly to the reading radiologists. It is also crucial in quality control issue. The methods to do audit and benchmarks of audit results were well addressed in the Breast Imaging Reporting and Data System® (BI-RADS) by American College of Radiology (ACR).
However, the known breast cancer incidence rates are quite variable among different populations. The recommended audit benchmarks by ACR are therefore subject to further adjustments to fit a different population.
Methods: By using Taiwanese population as an example, we proposed some adjustments based on the difference of breast cancer incidence rates and the assumption of equal well mammographic screening performance.
Results: Our inference equation shows that both positive predictive value for the screening (PPV1) and cancer detection rate (CDR) need to be further adjusted by different incidence rates; the equations are almost equal to the ratio between two different incidence rates.

Audit feedback on reading performance of screening mammograms: An international comparison

Hofvind S[1], Bennett R[2], Brisson J[3], Flugelman A[4], Lee WB[5], Wall M[6], Geller BM[7]
[1]Cancer Registry of Norway, Oslo, Norway; [2]St. George's, University of London, London, United Kingdom; [3]Institut National de Sante Publique du Quebec and Laval University, Québec, Québec, Canada; [4]Clalit Health Services National Israeli Cancer Control Center, Carmel Medical Center, Haifa, Israel, [5]Cancer Institute New South Wales, Sydney, New South Wales, Australia; [6]Wellington Hospital, Wellington, New Zealand; [7]University of Vermont, Burlington, Vermont, United States

Background: The effectiveness of mammography depends on the ability to perceive mammographic abnormalities and interpret these findings accurately. Both tasks are challenging and require ongoing education to maintain and improve interpretative skills. Recognizing this, some countries with mammographic screening programs have developed audit feedback systems to help screen readers to assess and improve their reading skills. These audit feedback systems can include formal systems such as those provided to a program by an independent unit as well as informal systems in which a reader audits their own reading performance, or audit feedback may be provided verbally to a reader by a medical leader.
Methods: Members from seven countries of the International Cancer Screening Network (ICSN) formed the Radiologists' Audit Feedback Working Group in 2008 to share their knowledge about outcome audits and to create a survey to learn about audit feedback in member countries offering mammographic screening. The survey consists of four sections: characteristics of the screening program; general aspects of audit feedback; audit feedback to the individual reader; and audit feedback to the facility. The survey is being administered through the ICSN website and will be completed by the summer 2012.
Results: Frequencies of responses will be reported. We will create a table to display the most interesting results by participating country.
Conclusion: We will discuss the value of the results and make recommendations for the next steps for countries that are considering developing or improving their audit feedback.

Outcomes of mammograms selected for double read in the context of the Nova Scotia Breast Screening Program

MacInne M[1], Payne JI[1], Foley T[2], Caines JS[1], Iles SE[3]
[1]Dalhousie University, Halifax, Nova Scotia, Canada; [2]Nova Scotia Breast Screening Program, Halifax, Nova Scotia, Canada; [3]Queen Elizabeth II Health Sciences Centre, Halifax, Nova Scotia, Canada

Background: Quality assurance is an integral component of organized breast cancer screening programs in Canada. The Nova Scotia Breast Screening Program (NSBSP) requires double reading of every tenth screening mammogram. The double reads are performed blindly in real-time, with discrepant reads resolved by a third, blinded radiologist. The NSBSP is reconsidering criteria for selecting mammograms for double reading. This study aimed to describe outcomes of the review process for mammograms selected for double reading by age group, order of screen, and technology.
Methods: The sample included all mammograms selected for the double-read process at the Queen Elizabeth II Health Sciences Centre for the period January 2001–December 2010. Analyses were conducted to identify the proportion of results that changed as a function of second and third reads. Analyses were carried out for the full sample, as well as by 10-year age group, order of screen (first, subsequent), and technology (analog, digital).
Results: Of the 14,927 mammograms included in the audit, 14,767 (98.9 percent) were normal on first read. Of these, 14,382 (97.4 percent) remained normal on second read. In contrast, of the 160 abnormals on first read, only 79 (49.4 percent) remained abnormal on second read. A total of 464 (3.1 percent) triple reads were required. Triple read rates were highest for abnormal on first read, youngest age group, and first screen.
Conclusion: The results suggest that this approach to double reading would be most beneficial in certain subgroups of the screening population.

Assessment and comparison of performance of designated centers in the Quebec breast cancer screening program, Canada

Pelletier E[1], Daigle JM[1], Theberge I[1], Brisson J[1,2]
[1]Institut National de Santé Publique du Québec, Quebec City, Quebec, Canada; [2]Centre Hospitalier Affilié Universitaire du Québec, Quebec City, Quebec, Canada

Background: The Quebec breast cancer screening program, initiated in May 1998, invites women ages 50 to 69 to have a mammogram every 2 years.
Methods: Performance indicators used to evaluate and monitor the performance of designated screening centers include detection rate, recall rate, and number of false-positives per cancer detected ((1- positive predictive value)/positive predictive value). These indicators are measured at initial and subsequent screens separately. The percentage of cancers that are in situ, the percentage of invasive cancers of small size, and the percentage of invasive cancers without axillary node invasion are also used. The performance of each center is compared to the average performance achieved by the entire program and to program targets. The indirect standardization method is used to adjust for possible difference in case-mix (characteristics of women) by center. This method generates a ratio of an observed rate in a given center to an expected rate. The expected rate is calculated with a logistic regression model based on the performance observed in the entire province and the center's case-mix. Moreover, due to small numbers, the statistical variability of performance indicators is taken into account with an estimation of confidence intervals calculated using a normal approximation based on a log-transformation of the ratio (observed/expected). Graphs were developed to facilitate the analysis and interpretation of performance results. The first type of graph presents the trends over time of the nine indicators for each center and compares its performance with the average program performance and the program target. The second type of graph presents all centers according to the number of false-positives per cancer detected on x-axis and the detection rate on y-axis. The same methods and graphs are produced and used to evaluate and monitor the performance of radiologists.
Results: The use of these graphs has become a major component of evaluation of the performance of the program and feedback to radiologists. In the last 3 years, the graphs were used by a provincial committee that includes representatives from the Ministry of Health, the Quebec Association of Radiologists, and the Quebec College of Physicians, which is responsible for monitoring program performance. If a center appears in need of support, a group of experts is mandated to visit the center and provide advice. The graphs are also sent to those responsible

for quality assurance at the regional level and to each radiologist in the program. Finally, each radiologist can obtain the graphs of his own performance.

Continuous quality improvement for assessment colonoscopy in the Queensland Bowel Cancer Screening Program: Quality measures and variation

Steele RM, Di S, Wardle B, Spuuches C, Thompson A
Queensland Bowel Cancer Screening Program, Queensland Health, Herston, Queensland, Australia

Background: The Queensland Bowel Cancer Screening Program (QBCSP) has established an Authorised Provider Model in the public sector to ensure organised and standard provision of colonoscopy services for participants following a positive faecal occult blood test (FOBT). This is done by identifying and authorising designated facilities and specific proceduralists (authorised providers) who demonstrated they met quality standards set by the Program. The aim of this paper is to examine the quality of colonoscopies in the QBCSP and its variation across authorised providers. Reducing variation is a key component to quality and continuous improvement.
Methods: The QBCSP collected clinical data on colonoscopies undertaken for participants in 11 catchment areas. Quality indicators measured included time to initial colonoscopy, satisfactory bowel preparation rate (target: ≥ 90 percent), caecal intubation rate (target: ≥ 95 percent), withdrawal time (ideal: minimum 6 minutes), adenoma (target: ≥ 35 percent), advanced adenoma and cancer detection rates, polypectomy rate, and rate of adverse events. The authorised provider continuous quality improvement process featured two-yearly cycles of analysis of performance data, feedback reports to providers, identification of quality improvement initiatives, and implementation in routine care. We report data between August 2006 (commencement of the Program) and June 2011.
Results: Sixty-seven providers performed 6,136 colonoscopies for 5,811 participants. Overall, the median time to colonoscopy was 36 days. Of the colonoscopies undertaken, 96 percent had satisfactory bowel preparation. Caecal intubation was achieved among 97 percent of initial colonoscopies. Of these participants, 64 percent had polypectomy; detection rates of adenoma, advanced adenoma and colorectal cancer were 48 percent, 26 percent, and 4.3 percent respectively. The rate of adverse events was 1.4 percent among colonoscopies performed. At the authorised provider level, there was less variation in performance related to satisfactory bowel preparation rate (range 86–100 percent across providers) and caecal intubation rate (range 79–100 percent), but greater variation in performance in terms of polypectomy rate (range 35–83 percent), adenoma detection rate (range 21–71 percent), and advanced adenoma detection rate (range 12–52 percent).
Conclusion: Overall the QBCSP provides high-quality public sector colonoscopy services to participants as shown by high caecal intubation and adenoma/cancer detection rates and low adverse events. There is a need to better understand sources of variation in performance across authorised providers and to reduce variation through ongoing continuous quality improvement.

International Test Sets

Test set for measuring performance of radiologists in the Norwegian Breast Cancer Screening Programme

Ertzaas AK[1], Austgulen A[2], Hofvind S[1]
[1]Cancer Registry of Norway, Oslo, Norway; [2]Curato X-Ray, Bergen, Norway

Background: The effectiveness of mammographic screening depends on the radiologist's ability to interpret the screening mammograms. A key issue is to maintain and improve the interpretation skills. The European Guidelines recommend that each screening radiologist undertake to read a minimum of 5,000 screening cases per year and be involved in assessment and clinical mammograms. Reviewing prior screening mammograms of breast cancer cases is an important part of the quality assurance of the radiological work. However, this work is time consuming and might be biased due to site-specific and reader characteristics. As a supplement to the recommended quality assurance, test sets of screening mammograms might be one way to increase the sensitivity of the reader performance. As a part of the quality assurance of the reader performance, we decided to create test sets of screening mammograms for this purpose.
Methods: We will establish 5 test sets of 100 2-view screening examinations. The mammograms will be randomly selected from the national screening database and obtained from selected hospital picture archiving and communication systems. A registration system for interpretation score and mammographic features will be developed. A reporting module with possibilities for immediate feedback regarding the interpretation (true and false positive, true and false negative, and mammographic features) will be created. A basic approach for the test sets is possibilities for processing new mammograms and by that regularly updating the test sets. Radiologists will be used for usability testing during the working process of establishing the database and the feedback system related to effectiveness, efficiency, and satisfaction in a specified context of use.
Results: Frequencies of results will be reported. We will create a table to display the most interesting findings.
Conclusion: We will discuss the value of the achieved results and responses from the radiologists.

The International Cancer Screening Network (ICSN) screening mammography test set

Yankaskas BC[1], Broeders M[2], Bulliard J-L[3], Frigerio A[4], Lee WB[5], Miglioretti DL[6]
[1]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, United States; [2]National Expert and Training Centre for Breast Cancer Screening, Nijmegen, The Netherlands; [3]Institute of Social and Preventive Medicine (IUMSP), Lausanne University Hospital, Lausanne, Switzerland; [4]Regional Reference Centre for Breast Cancer Screening, Torino, Italy; [5]Cancer Institute New South Wales, Sydney, New South Wales, Australia; [6]Group Health Research Institute, Seattle, Washington, United States

Background: While breast cancer incidence rates are similar in the United States and many European countries, there is variation in the performance of screening mammography, with sensitivity having much smaller variation than specificity. Recall rates are known to differ internationally but likely do not explain all variation. A workgroup was established within the International Cancer Screening Network (ICSN) to develop a test set that could be used across international sites to compare the interpretative ability of radiologists practicing in different screening environments.
Methods: The workgroup began with presentations at the 2010 ICSN meeting from representatives of countries where test sets had been developed and used. The workgroup established principles and objectives for an international test set. A small working group was created to design the test set and the methods for disseminating and evaluating it. The test set will be used to: (1) compare radiologists' interpretative ability among different screening programs/countries, and (2) provide evaluation and continuing education for practicing radiologists.
Results: The guiding principles are as follows: (1) test set mammograms will be digital, two view, and represent first and subsequent screening; (2) subsequent mammograms will have comparison mammograms from a minimum of 2 years prior; (3) images will be viewed as soft copy on viewing work stations that will have zooming

features; (4) 60–100 cases will be included, and readers will be blinded to the case mix; (5) selection of mammograms will be decided by an international expert panel of radiologists; (6) a Web-based application will be developed for recording of test set results; (7) the workgroup will develop the test set for the international comparison, and (8) it will be widely available for educational purposes. The methodology will be finalized by the 2012 ICSN meeting in Australia.
Conclusion: The poster will present the final methodology for the international test set, and the Web software will be demonstrated along with the poster.

International Cancer Screening Network 2012

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